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Chicago Transportation Experience

This Issue—Its Aim

CUSTOM has led to the expectancy in the electric railway field that this issue of *Electric Railway Journal* would be devoted to the Chicago traction properties as Chicago is the convention city this year. The theme of the annual convention souvenir number has usually been a comprehensive description of the railways centering in the convention city, except when this was Atlantic City. A departure from the usual theme, however, seemed advisable and desirable this year, for several reasons.

In 1912 such an issue was prepared on Chicago, that being the date of the last Chicago convention. In the ten years since then the changes in the physical properties of the elevated and surface lines in Chicago have been comparatively of small proportions or importance on account of unfavorable political circumstances, and what additions have been made have been thoroughly treated in this paper as they occurred. Furthermore, in 1912 there had been under way for the previous five years a comprehensive rehabilitation of the surface lines with the adoption of certain standards of construction and design in nearly all phases of the physical construction and equipment of the surface properties. These subsequent ten years have thoroughly tested out the designs installed and have developed the defects and the strong features. Here, then, was the theme about Chicago of greatest interest and value to the men of the industry generally: What has been Chicago's experience with the kind of construction and equipment in use there under the extremely heavy traffic conditions?

The aim of this issue has been to answer that question, and to point out the successive developments made in design and construction as dictated by the experience with the previous designs. This theme of operating experience was applied also to the articles requested from the members of the elevated organization, with equally interesting and instructive results as regards rapid transit.

Again, the Chicago-Milwaukee electric railroad has had an experience in these last six years in building up an interurban system which is probably without parallel in the annals of the business. This organization has also had much experience in what is required of the various elements of the physical property of a high-speed heavy traction line. The experience along these lines is ably represented in the articles by North Shore officials which follow. They will prove of great interest and suggestive value to other interurban men.

Street railway, rapid transit and interurban operating experience, as known to these three outstanding companies of the industry, are therefore treated in the following pages. It is only regretted that twice as many pages could not be devoted to these Chicago companies, for the wealth of their experience has been by no means exhausted.

The Convention City as a Center for Transportation Study

THE annual convention of the American Electric Railway Association in Chicago this October will bring to that great central city several thousand electric railway executives, engineers and operating men. These men will come with minds open to new methods or ideas about the conduct of their business. The convention meetings and the exhibits will doubtless supply much food for reflection. But this is not all. Attendance in Chicago affords an opportunity for first-hand observation and study of the several classes of electric railroading such as is available in no other city. Here are the largest street railway system in the world with all its ramifications; the very small but well-equipped and operated street railway company in Evanston; the 190-mile system of rapid transit elevated railways; five important radiating interurban lines, including third rail and trolley, plain span and catenary, 600 volts d.c. and 6,600 volts single phase, special and M.C.B. equipment; two strictly suburban electric railways, and an electric underground freight subway. Then if the electric railway man chooses to look beyond the scope of his immediate kind of transportation service, there is in Chicago the largest and most conspicuously successful taxicab company in the world, and one well-established, successful, large motor bus company and several smaller ones.

The average railroad man can get a lesson out of the remarkable precision with which the elevated trains may be observed to conform to the schedule. There are reasons fundamental behind such service, of course, and one might spend many hours most profitably in searching into the inspection and maintenance methods in the shops, in the way department and the electrical department, for the detailed explanation. When it is considered that a considerable part of the elevated equipment is very old, this service performance reputation is only the more notable. It is made possible only through a systematic and rigid system of maintenance—unstinted

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maintenance. But the schemes evolved and equipment adopted to lessen the cost of such maintenance may be of greatest interest, for much has been done in this direction and the elevated men are able and ready to tell about it when asked. Another matter that should not be overlooked is the recent introduction by the Elevated of the use of the pass. This is an innovation in selling transportation that has not been in use in Chicago sufficiently long to afford any real criterion as to what it may or may not do to increase elevated patronage, but there are some points in connection with the physical application of the plan that can be observed on the spot.

As to the surface lines, the extent of the system is so great and the problems involved are of such magnitude that there is plenty to arouse the keen interest of street railway operating men and to expand their imaginations in trying to grasp the vast ramifications of a system which carries 750,000,000 revenue passengers a year. In fact, to comprehend the full meaning of any proposed important change has been one of the great difficulties, almost impossibilities, on the part of the management or of experts called in, a circumstance which has developed in the company a high degree of conservatism in considering innovations in equipment or operating practice.

One may observe as much data as to wear and life of elements of street railway property in one day in Chicago as could be gained in a month in the average city, so heavy are the mileage and vehicular traffic and so severe the operating schedules. It is a common remark of many who know Chicago street car service that there are only two points on the controller—on and off. This is an exaggeration, of course, but it does characterize about how rapidly the motormen accelerate their cars. The controller is also kept right against the post during the running period and the rate of stop is as fast as the acceleration. A motorman from another city visiting Chicago and riding on the front end expressed his idea of the speed in this characteristic way: "This ain't streetcarin'; this is railroadin'." This is a rather extended discourse on "Chicago's speed," but the point of it is that the almost complete absence of "loafing along" of cars, the feeling the passenger gets of being hurried to his destination, and the close headway, probably have a great deal to do with the ability to secure the enormous business of 278 annual revenue rides per capita in a territory where both elevated railroads and buses are also important transportation factors.

For men of all departments of the street railway, there is in Chicago an opportunity to spend with greatest profit all the time that can be spared to study the working tools and practices of the Chicago Surface Lines.

The third road to which it is desired to direct particular attention is the Chicago, North Shore & Milwaukee Railroad. There are several well-operated and interesting interurban properties entering Chicago which are well worth inspection and study. But one who is interested in high-speed intercity electric railroading can scarcely discuss the North Shore Line without becoming enthusiastic. What may be learned here from first-hand observation can be gleaned perhaps from the articles herein published. The editors of this paper feel that any interurban railway man attending the convention who goes home without having ridden over the North Shore Line to Milwaukee and back will do himself and his company a great injustice.

Chicago Men Respond Generously

AT A great sacrifice of time and effort, the Chicago railway men whose names are signed to the articles in this issue have responded to the request and plan of the editors to write articles setting forth certain aspects of their experience for use at this particular time. The summer for these men has been one of greatest stress, for the burdens of handling a strike have been imposed on top of the pressure of an exceedingly heavy program of new operating methods and betterments. And heaped on top of this have been the many details of arranging for the convention, much of which has devolved upon them. Nevertheless, time has been found to produce their part of Chicago's issue of the *Journal*, though several have expressed disappointment that they had been unable to make their articles all that they would wish them to be.

This generous response to the *Journal* only bespeaks the broad interest of these men in giving freely of their time, energy and experience toward the general advancement of the art. The Chicago men have much to give in the way of experience, for in their methods and in the magnitude of their properties and traffic, they are among the leaders in the traction business. Yet these men are keen to learn and take advantage of any better ways and means found by any other companies. This accounts for their willingness and desire to reciprocate by contributing to this special issue for whatever help it may be in the common good.

Safety a Most Prominent Topic at This Convention

SOME ten years ago a writer in one of the popular magazines referred to the fact that at the previous convention of the American Electric Railway Association there was no paper on safety. Such a comment cannot be made on this convention. The Transportation & Traffic Association has a committee on safety which will render a report, but this is not all by any means. In fact, the subject of safety is by all odds the most prominent one on this year's program. In the first place, the convention of the Claims Association will be given up largely to discussions of various phases of safety. In addition there will be a safety address at each meeting of each of the other affiliated associations by a representative of the Transportation & Traffic Association. Finally there will be a safety exhibit of commendable magnitude among the other exhibits at the convention. The forerunner of this exhibit was that made by this year's safety committee at the midyear meeting at Indianapolis. This exhibit attracted so much attention that the one in Chicago, which is toward the end of the Pier, is certain to be most valuable. It is being prepared on the basis of showing what safety means and what must be done to provide it. The motto of this year's work might well have been "Safety Again and Always."

Another departure in the program of the Transportation & Traffic Association this year is in the adoption of a "round-table" discussion, the subject in this case being interurban problems. Of course many other topics on the program concern directly or indirectly interurban electric railways, but on this particular afternoon a definite time has been set apart for the interurbans. There should be a full attendance at this meeting.

Carrying a Billion Passengers a Year in Chicago

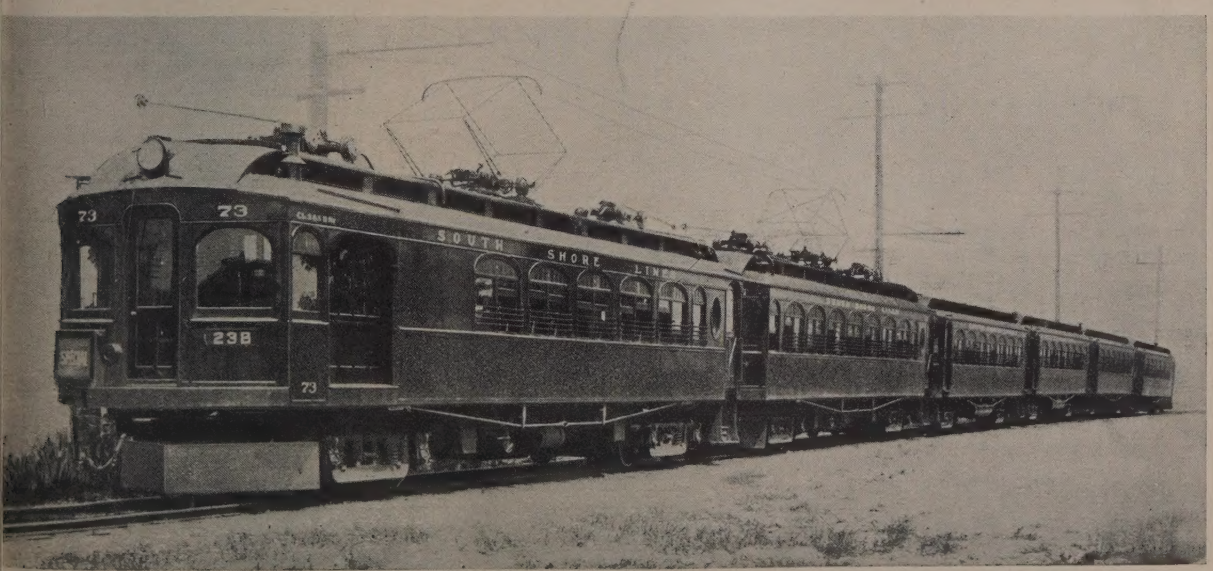
OF THE LOCAL and suburban riding, the elevated and surface lines carry 90 per cent, with the steam roads the next largest factor. The several railway companies supplying these services are characterized and the tendencies in their traffic cited

DURING the year 1921 Chicago and environs supplied a passenger traffic to all the local and suburban transportation agencies of well over one billion revenue passengers. In this business of supplying services equivalent to the gigantic task of handling the entire population of the United States ten times over in a year, the Chicago Surface Lines stands out predominantly with its enormous traffic of more than 750,000,000 revenue passengers. The Chicago Elevated Railroads come next with a service which was used by well over 180,000,000 passengers. These two local companies handled more than 90 per cent of the billion rides required by the public in Chicago and adjacent territory. Despite these huge totals of the local railways, it is rather startling to note that even with the very excellent service rendered at extremely low rates by these local railways, 14,250,322 persons bought the comparatively high-rate special personal transportation afforded by the Yellow Cab Company, and that probably an equal number used other taxicabs, or a total of perhaps 30,000,000 taxicab riders in 1921 in Chicago—twelve taxicab rides per capita per year.

Motor bus lines, principally the Chicago Motor Bus Company, operated by a former street railway man, carried another 8,500,000 passengers. While this is a comparatively new branch of the local transportation services, the traffic available for hauling in buses is increasing at a remarkable rate, and another ten years may easily see this class of traffic climb up into totals perhaps nearing those of the elevated lines. The electric and steam lines serving the suburban riders enjoyed a business numbering more than 100,000,000 passengers, of which the larger share was carried by the steam railroads, as noted in detail in the accompanying table.

The rush-hour condition in Chicago presents the usual difficulties met with in all large cities, but it is especially acute on the elevated system, on which about 65 per cent of the twenty-four-hour traffic is hauled between 6 and 9 a.m. and 4 and 7 p.m. Some of the surface lines have an equally excessive proportion of rush-hour travel, particularly those serving the manufacturing and Loop districts, the entire surface lines system carrying 53 per cent during the above mentioned rush hours. Of the twenty-four-hour total surface lines revenue and transfer traffic, the rides between 7 and 8 a.m. represent about 16.5 per cent, and those between 5 and 6 p.m. around 18.3 per cent. Between 250,000 and 300,000 rush-hour passengers are carried into the Loop in the morning and out in the evening on the surface lines.

Unfortunately for all concerned,



Limited train on the Chicago, Lake Shore & South Bend single-phase railway passing through the sand dunes at the foot of Lake Michigan

the elevated is handicapped by a limitation of track capacity in the Loop, for which the remedy is plain but it seems quite remote of execution. Thirteen main-line rapid transit tracks converge into a two-track loop in the center of the city. The track capacity of the loop therefore largely determines the capacity to haul passengers in the rush hours.

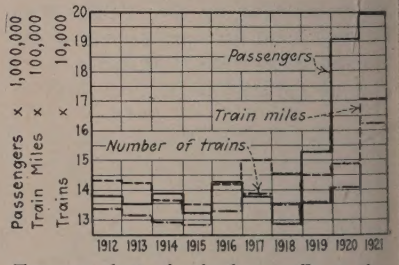
The 1,250-mile network of rapid transit and street car lines which serve Chicago

REVENUE PASSENGERS CARRIED DURING 1921 BY URBAN, INTERURBAN AND SUBURBAN SYSTEMS OF CHICAGO

Urban electric:	
Chicago Surface Lines.....	750,515,622
Chicago Elevated Railroads.	180,629,282
	931,144,904
Urban bus and taxi:	
Chicago Motor Bus Co....	7,774,953
Depot Motor Bus Line.....	653,406
Yellow Cab Co.....	14,250,322
All other taxi companies....	*14,000,000
	36,678,681
Interurban electric:	
Chicago, North Shore & Milwaukee R.R.	11,944,126
Chicago, Aurora & Elgin R.R.	7,631,528
Chicago & Interurban Traction Co.	2,644,447
Hammond, Whiting & East Chicago Ry.	8,529,706
Chicago & Joliet Electric Ry.	2,813,979
Chicago, Lake Shore & South Bend Ry.	2,429,661
Chicago & West Towns Ry..	13,750,010
	49,733,457
Suburban steam:	
Illinois Central R.R.....	19,865,466
Chicago & Northwestern Ry.	20,428,531
Chicago, Burlington & Quincy R.R.	11,274,841
Chicago, Rock Island & Pacific R.R.	7,249,115
Other steam roads.....	*7,000,000
	65,817,953
Grand total	1,083,384,995

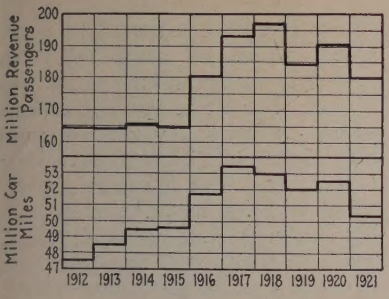
*Estimated.

Several plans for the improvement of Chicago's local transportation conditions have been made and reports submitted by various engineers and commissions since the Chicago traction properties were given special attention in the Convention Issue of *Electric Railway Journal* when the convention was held in Chicago in 1912. The population of Chicago during this ten-year period



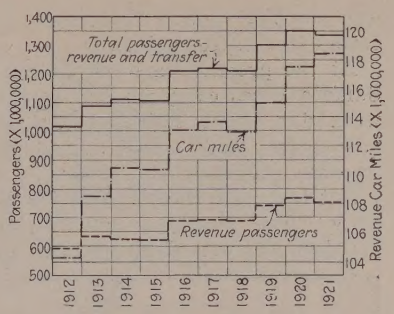
Ten-year chart of suburban traffic on the Illinois Central Railroad

has increased from 2,185,000 to 2,700,000, or about 23½ per cent. But its transportation facilities have remained substantially the same, that is, the additional traffic resulting from larger population has been taken care of by the individual expansion of the surface and rapid transit systems. In neither case has the increased capacity been obtained by a material addition to trackage, but almost entirely by the improved operating efficiency and by the addition of more rolling stock. During the period in question the revenue



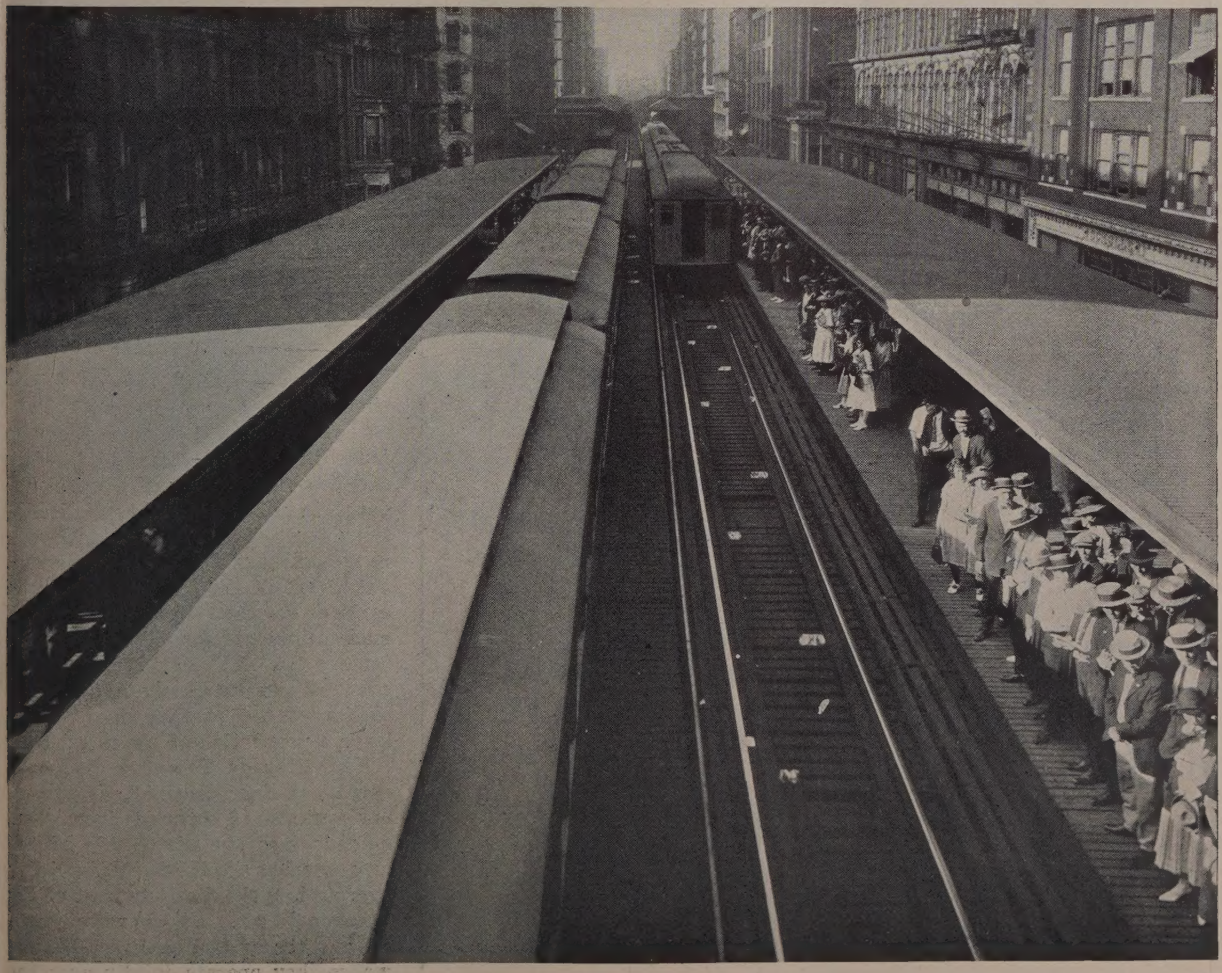
Ten-year trend of traffic on the Chicago Elevated Lines

track mileage of the Chicago Surface Lines has been increased from 884 miles to 990 miles. The trackage of the elevated lines is essentially the same as it was ten years ago. During 1921 the revenue passenger traffic of the Chicago Surface Lines amounted to about 750,000,000 and that of the Chicago Elevated Railroads to approximately 180,000,000. For 1912 these two figures were respectively 594,000,000 and 164,000,000. Thus surface travel shows an increase of 24.6 per cent and elevated traffic slightly less than 10 per cent. It is seen, then, that surface car riding has tended to keep pace with the city's growth, while rapid transit riding has built up at a slower rate. The ratio of the number of revenue passengers on the surface lines to the number on elevated lines has risen from 3.6 to 4.2 over the past ten years. The per capita riding on the surface lines is now 268, which is six more than in 1912. The number of elevated rides annually per capita has decreased from 75 to 64.3 in the same period.



Ten-year traffic chart for the Chicago Surface Lines

It is probably a fair statement that the Chicago Surface Lines represents the highest development of surface street railway service known to the industry. It is of particular interest and importance not only because of its place as the largest system of its kind in the world, but because of the speed and general excellence of the physical property and the service. This system comprises 1,060 miles of single track, forming a network of street car lines running in general either north and south or east and west with a few diagonal lines intersecting the rectangulr system, which rather completely covers the 199 square miles area of the city. The diagonal lines and a large proportion of the north and south and east and west lines pass through or terminate in what is known as the "Loop District." On all of these surface lines a transfer is allowed at practically every intersection, which results in an annual interchange of

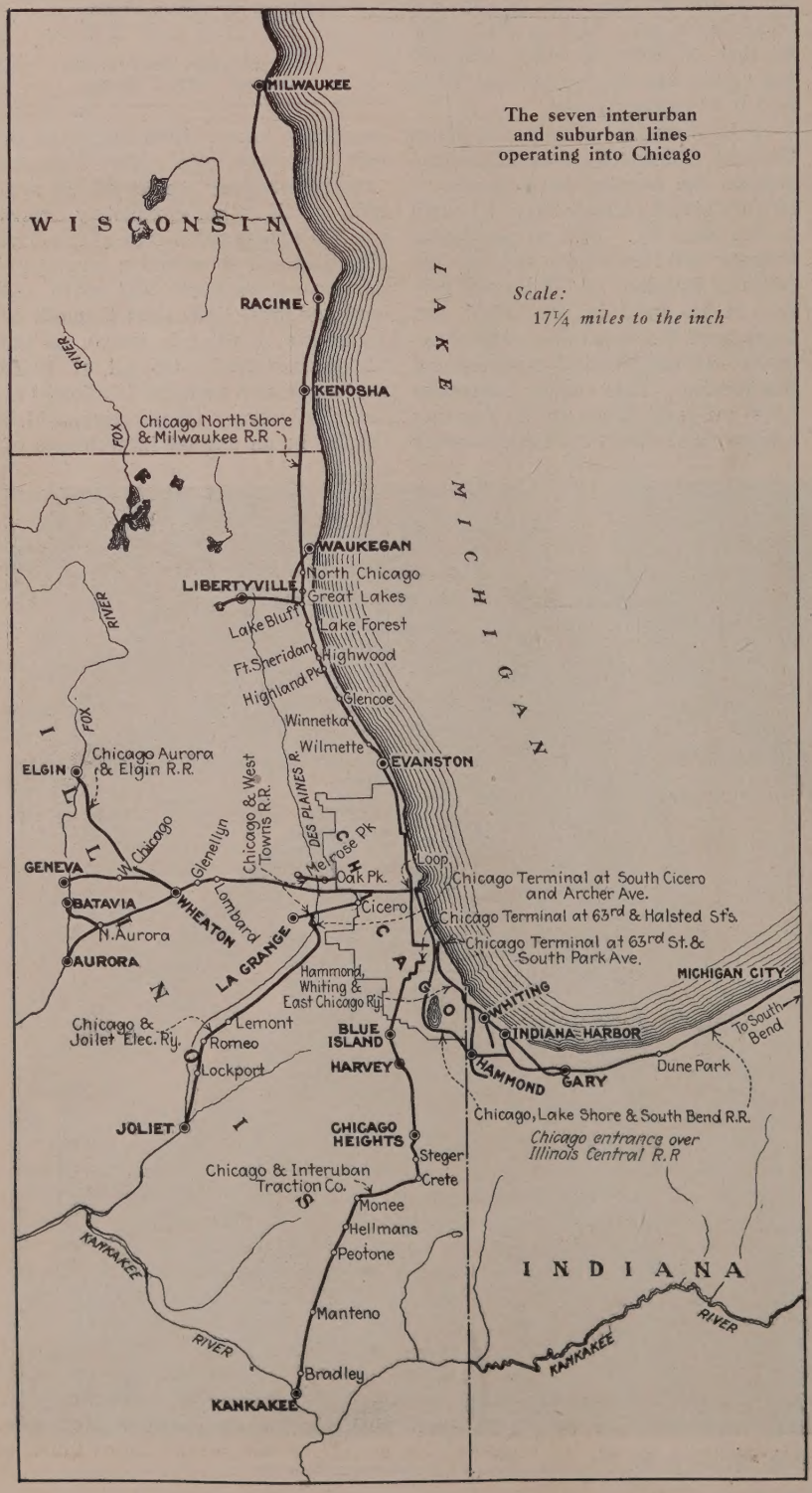


At Adams and Wabash Station of the Elevated early in the evening rush hour

over one-half billion passengers at some 575 transfer points.

At the present time the Chicago Surface Lines carry on an average week day about 2,200,000 revenue passengers and about 1,700,000 transfer passengers. There is a 7-cent fare with three tickets for 20 cents. The universal transferring privilege prevails with one, two or more transfers allowed a passenger as long as he travels in the same general direction. This universal transfer system has developed an average haul on the surface lines which is longer than for similar systems elsewhere. The average length of ride per fare of a surface car passenger is about 4.16 miles.

One of the operating features of the surface lines is the high average speed, which in some cases approaches rapid transit running time. In fact, the system average schedule speed, excluding layovers, is probably higher in Chicago than in any other city. This Chicago average speed is 10.64 m.p.h. On some of the outlying lines schedule speeds reach as high as 15 m.p.h., so that now many passengers using the surface lines virtually receive rapid transit service. The reason for the high speeds is partly the wide streets through which many of the cars run, but principally because of the good physical condition of the roadway and rolling stock, the ability of the cars to accelerate and retard at high rates, and the training of the men to make high speed. Owing to the large amount of special trackwork, about 10 per cent of the total mileage, a variety of routings are obtained which permit great flexibility in operation.



The lowest speeds are reached naturally in the congested Loop district. Even so, the average speed through the Loop from 4:30 until 10:30 p.m. is 6.24 m.p.h. Speeds in the Loop are lowest between 4:30 and 5 p.m., when the average is 4.83 m.p.h., but after much of the trucking has been withdrawn from the streets the speed rapidly rises to 5.57 as an average between 5:30 and 6 p.m. For the following half hour the average Loop speed is slightly more than 7 m.p.h.

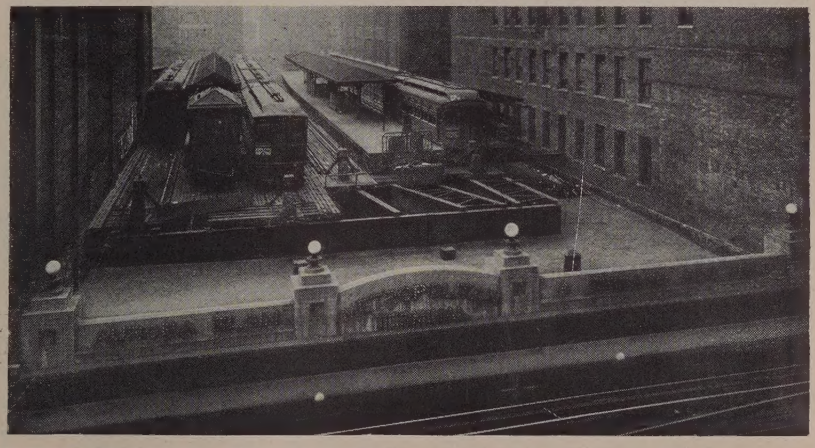
Elevated Lines Progress Under Severe Competition

Perhaps the most notable things about the Chicago Elevated Railroads are the substantial progress made in amount of traffic handled and the high quality of service rendered in spite of the severe limitations imposed by the two-track loop in the center of the business district. Furthermore, the excellence of the service on the surface lines had made of them a formidable competitor for the "L," particularly on account of the immensely better availability of the surface lines for so large a proportion of the population.

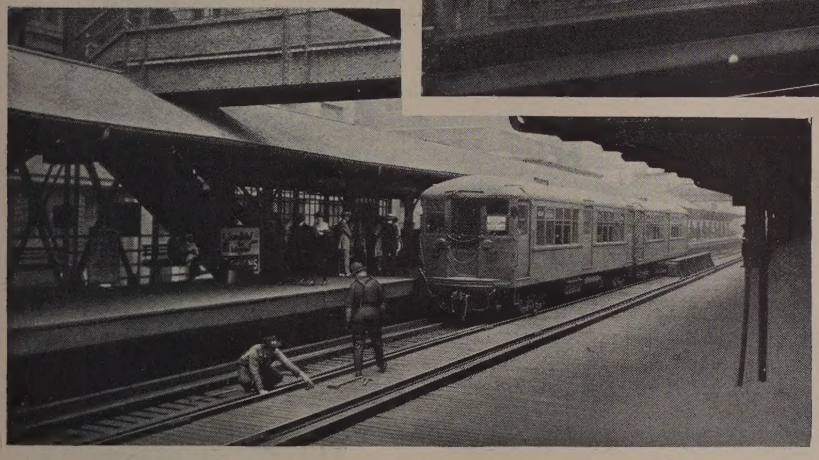
The Chicago Elevated Railroads consist of four originally independent systems of elevated lines. One extends into the south side of the city, another the north side, and two operate into the districts west of the Chicago River. All, however, converge in the central business district, where they operate jointly over the two-track elevated structure known

as the Union Loop, and from which Chicago's downtown section derives its reference—"in the Loop."

The consolidated elevated system offers through one-fare service north and south by trains running directly through the Loop district. By means of bridges over the tracks, free transfer privileges afford a one-fare service between the west, north and south sides of the city. Prior to 1911 the elevated railroads of Chicago were operated by different managements. During 1911 the operating unification of all of the elevated railroads was brought about by placing them under one management. In 1913 the through routing from north to south and the transfer privileges between the different roads were instituted. The elevated lines now comprise 197 miles of single track, with more than 200 stations located in general at intervals of about one-third mile. An express service is given on portions of the lines by third and fourth tracks and by a system of skipping stations on some of the two-track lines.



Chicago Loop Terminal of Chicago, Aurora & Elgin Railroad



Modern steel car train of Chicago "L" at a Loop transfer station

The condition therefore now exists that all of the surface lines and all of the elevated lines have, respectively, been unified with a single fare and universal transfer privilege on either system. Between Wilmette and Jackson Park, a distance of 23 miles, a passenger may ride on the elevated without changing cars for a fare of 13 cents. On the surface lines the longest ride without transfer is 20 miles, while a person may ride in a forward direction by transferring a distance of nearly 33 miles.

One of the most noticeable characteristics of the traffic curve for the elevated lines is the decided slump in riding since 1918. With the increases in fares that came to both the surface and elevated lines in 1919 the differential between them was also increased. In that year there was a sharp decline in traffic on the elevated and more than a corresponding increase on the surface lines. Normalcy in this respect has not yet been reached because the 1 cent fare cut on the Chicago Surface Lines in June, 1922, again widened the gap between the two fares. The type of rider who has been lost by the elevated is of the profitable, short-haul variety. This has meant that the average length of haul on the elevated has increased year by year until now it is approximately 6.75 miles.

In spite of these handicaps the elevated has maintained a very high standard of service and practiced all economies that were possible without a detriment to the service. The continuity and reliability of its service are particularly notable when it is remembered that the only modern equipment in use on the elevated consists of 250 steel cars, of which 184 are motor cars and sixty-six are trailers. The addition of this equipment, which was placed in operation on Jan. 1, 1915, increased the carrying capacity of the roads approximately 24 per cent. To keep the average speeds as high as possible with the older equipments it has been necessary to increase their rate of acceleration to the limit of the motor endurance. In doing this, motors operate continuously at temperatures as high as 275 deg. F., and even so, motor failures are extremely rare occurrences. Delays from power interruptions are practically unknown.

Interurban Lines Entering Chicago

The suburban and interurban electric lines entering Chicago are not as numerous as in some other Mid-Western cities. In all there are seven interurban and suburban electric lines that either enter Chicago or connect near the city limits with either the surface or elevated systems. Only three of these give service directly into the Loop district. The Chicago, North Shore & Milwaukee Railroad, which formerly came only to Evanston, now operates over the tracks of the Northwestern Elevated through the Loop and as far south as Sixty-third Street and South Park Avenue on the south side. The Chicago, Aurora & Elgin Railroad enters the Loop over the Garfield Park branch of the Metropolitan West Side Elevated Railroad. Through an operating agreement with the Illinois Central Railroad the Chicago, Lake Shore & South Bend Railroad, which runs to Hammond, Gary, Michigan City and South Bend, operates trains into the suburban stations of the Illinois Central Railroad, adjacent to the Loop along Michigan Avenue.

Connecting with the surface lines on the southwest side of the city is the Chicago & Joliet Electric Railway, which operates high-speed interurban service into Joliet on an

Chicago & Interurban Traction Company car at terminal connection with Chicago "L"

hourly schedule. In that section also is one line of the Chicago & West Towns Railway, connecting Cicero with La Grange. This company operates another line from Oak Park to Melrose Park. A line to Kankakee, Ill., starting from Sixty-third and Halsted Streets on the south side is operated by the Chicago & Interurban Traction Company. The Hammond, Whiting & East Chicago Railway is a suburban system which extends from Sixty-third Street and South Park Avenue, Chicago, to Hammond, Whiting and East Chicago, Ind. This is operated by the Chicago Surface Lines. All of these lines to the outlying districts have helped materially to build up the suburban communities served. They are all shown in accompanying maps.

The total steam suburban service into and out of Chicago amounts to nearly 60,000,000 passengers annually. It will be noticed that of the total, the Illinois Central carries nearly 20,000,000 passengers per year, while the traffic curve for the past ten years shows that the riding reached this figure after a phenomenal increase during the past three years.

The suburban service of the Chicago & Northwestern Railway, the Chicago, Burlington & Quincy Railroad, and the Chicago, Rock Island & Pacific Railway is perhaps more accurately speaking truly suburban, while that of the Illinois Central approaches closely rapid transit city transportation. The tracks of the first three roads mentioned pass through a large non-productive territory within the city limits, while the major part of the Illinois Central traffic is within the thirty-minute zone from Randolph Street. The suburban stations on the Illinois Central are scattered frequently along its right-of-way and the average length of ride is 8.4 miles, bringing the center of traffic near Jackson Park. The average length of ride on the three other roads is considerably greater.

DATA ON THE FOUR STEAM ROADS HANDLING THE LARGEST CHICAGO SUBURBAN TRAFFIC, 1921

	Passengers	Train Miles	Avg. Number Cars Per Train	Avg. Length of Ride
Illinois Central	19,865,466	1,709,558	...	8.4
Chicago & Northwestern	20,428,531	1,836,417	7.75	15
Chicago, Rock Island & Pacific	7,249,115	550,000	7	13.3
Chicago, Burlington & Quincy	11,274,841	593,069	6.5	16.3

The average number of passengers handled on a week day is about 73,500 and on Sundays it amounts to about 25,700 passengers. During an average week more than 2,000 trains are operated or about 320 to handle the normal week-day traffic.

On a normal business day the average number of passengers carried in and out of Chicago by the suburban trains of the Chicago & Northwestern Railway is approximately 60,000. To handle this business 166 trains are necessary.

The suburban business of the Chicago, Rock Island & Pacific Railway has also shown a steady increase year by year. Last year the suburban traffic amounted to approximately 22,000 passengers on an average week-day. The increase in street railway and elevated fares in Chicago several years ago diverted a large number of people to the Rock Island service and many of these have continued to be regular patrons of the steam line.

As an indication of the growth of the suburban traffic on the Chicago, Burlington & Quincy Railroad since 1913, it may be cited that the gross passenger revenue of that road in the Chicago suburban districts increased from $666,660 in 1913 to $1,143,425 in 1921, or an increase in round figures of 72 per cent. The total number of suburban passengers handled in 1921 was 11,274,841. The annual suburban train mileage, which in 1921 was about 593,000 train-miles, showed an increase of about 65,000 train-miles over 1918, or about 12 per cent. The average length of ride per passenger on the Burlington is 16.3 miles.

Trailers have greatly improved the rush-hour capacity of the Chicago Surface Lines

Dealing with the Labor Problem

By

BRITTON I. BUDD

President
Chicago Elevated Railroads
Chicago, North Shore & Milwaukee Railroad
Chicago & Interurban Traction Company

Mr. Budd snapped at a suburban North Shore station as a Limited train whizzed through

HOW to improve the human relationship between electric railroad companies and their employees, how to bring about a better understanding of the problems of the other by each side and how to secure greater co-operation for mutual benefit are questions transcending in importance any other in the industry today. It is a question which calls for the best thought of the executives who represent the companies and of the representatives of the employees.

The electric railway industry in recent years frequently has been referred to as a "sick" industry. This characterization had reference particularly to the financial side of the business. Costs of operation kept steadily mounting higher and higher, while net revenues fell lower and lower, with the result that a "sickness" developed to which many of the lines succumbed, while most of the others were reduced to a condition of weakness from which they have not yet recovered.

When the "sickness" became acute, a consultation of doctors was called to diagnose the case and, if possible, prescribe a remedy. The doctors agreed that the industry was being slowly starved to death through ignorance of the facts on the part of the public upon which the railroads depend for sustenance. Obviously, if the diagnosis was correct, the remedy was to give the public the facts, which was done through the Federal commission, created to conduct an inquiry and make known its findings and recommendations.

To continue the simile, are there not some symptoms of "sickness" in our industry in its relations with its employees? These symptoms may not be as widespread as were the financial symptoms, nor are they as easily discernible, but the outbreaks which we occasionally see prove that they are with us and call for a remedy.

Both forms of "sickness" to which I have referred have a common root. Both spring from ignorance of the actual conditions, from failure to see all sides of the problem, from a lack of correct information, which latter invariably leads to acceptance of misinformation and the drawing of wrong conclusions. The remedy applied in the first case, which resulted in at least a measure of relief, may be applied with equal success in the second place, and the companies are the doctors who must apply it.

In the age before the introduction of machinery in industry, and the resultant concentration of capital, there was no acute labor problem. The employer and the employee worked side by side. The human contact was ever present. The journeyman looked forward to the day when he would become a master. There was little room for misunder-

Under the complexities of our modern industrial system all that has been changed. The employer of today, at least in our industry, is not an individual but a corporation composed of hundreds or thousands of individuals, who may possess little or no knowledge of the business, and who have no interest, other than a financial one, in the enterprise. The

THE editors of *Electric Railway Journal* felt that an issue devoted entirely to Chicago would fall short of its mission if it did not tell something of the experience of the Chicago companies in the foremost consideration of the business—employee relations—particularly when the operating forces of these railways number so many thousands. Mr. Budd was therefore asked to contribute an article on this subject, the notable success he has had along this line being well known. Much of the reason for the success or failure of relations between management and men is a matter of intangibles. Something about the management begets the confidence of the employees—or lack of that characteristic inspires suspicion and disrespect. In this article Mr. Budd gives some pertinent thoughts from his experience on the tangible phases of how to better employee relations. That there is also present in his relations with the men that intangible something which supplies the element of confidence necessary to make the tangible remedy effective can best be judged by riding on the Elevated Lines or the North Shore Line and observing the courtesies shown to passengers and the general manner in which duties are performed.

—Editors

human contact so necessary in the way of establishing and maintaining friendly relations is impossible when the owners of the property on the one hand and the employees who operate it on the other number in the thousands. A wide chasm has been opened between the owners and the employees out of which arise all the mists of misunderstanding which cloud the vision and destroy the mutual confidence which is so desirable.

How is that chasm to be bridged and the human contact and mutual confidence restored? Manifestly it must be done through chosen representatives from each side, meeting and discussing frankly the problems in which both are equally concerned. If we agree that most of our industrial troubles come from a lack of understanding of each other's problems, from inability to see the other's viewpoint, it follows that we can never remove the cause by remaining apart. Frank discussion across the table I have found to be the best method of removing misunderstanding. But such discussions must be frank and straightforward. The game must be played with all the cards on the table face up. When it is so played mutual confidence is established, and grievances, real or imaginary, which appeared so large when the conference began, gradually diminish in size and importance or disappear entirely.

In every large plant where thousands are employed it is inevitable that grievances of one kind or another will arise. Many of them may be trivial in character, but if they are allowed to accumulate, if they are ignored by the management, they will grow in size and importance in the eyes of the workers and eventually result in an explosion. The better way is to dispose of them as they come up. When employees know that they can bring a grievance to the management, with assurance that it will be given fair consideration and be decided on its merits, it has a wonderful effect on their attitude toward a company. They feel they are being given a square deal and that feeling is reflected in their spirit of loyalty.

Employees of a large corporation are, as a rule, totally ignorant of the financial side of its operation. This is not to be wondered at, because they have not been given an opportunity to learn anything about it. That phase usually has been considered as none of the business of the employees. I do not agree with that view. I believe it is to the interest of a company to let its employees know more of its financial affairs. There is nothing secret about the financial affairs of public service companies because they are under public regulation.

Employees are ready, even anxious, to be educated on subjects which are of vital interest to themselves and to the companies, if only they are given an opportunity. My contention throughout is that in order to remove misunderstanding we must have understanding. I know of no way in which this can be done except by letting the employees know the facts in open, frank discussion.

There is a general tendency grossly to exaggerate the earnings of every utility company, especially electric railways. Newspapers frequently print stories of the large profits being made by this company or that, without the slightest regard for the facts.

Such stories are read by employees among others and they form an idea that they are not receiving a fair share of the fruits of their labor. A spirit of hostility is engendered as they talk among themselves of the alleged profits, in which they do not share to the extent they think they should. Misconceptions of this kind could not arise were employees more familiar with the financial side of our operations.

Definite Plan to Teach Financial Conditions

Some time ago in talking with a few of our employees I was amazed at the lack of knowledge they displayed with regard to the financial conditions existing on our properties. They were men, too, who might be expected to know more. As I thought over the matter the conclusion was forced upon me that the company was to blame rather than the employees, as it never had taken steps to educate them in that direction.

We now make provision for a depreciation of physical property. Why should not provision be made for human depreciation? The public would not, in my opinion, object to such a charge in the rate of fare to be paid for transportation service.

Out of that short conversation came an idea for educating the employees on the financial and business side of our operations. We looked around and selected Prof. Ralph E. Heilman, dean of the school of commerce of Northwestern University, to conduct a series of ten lectures on the subject. He is a man with a national reputation for such work and his years of experience as a teacher enable him to put his message across in plain and simple language, easily understood by the ordinary layman.

Notices were sent to all our men employed in a supervisory capacity of any kind, on the road, in the shops and general offices. They were offered an opportunity to attend these lectures at no expense to them, other than an evening's time once a month. While it was made known to them that their attendance would be gratifying to the management, there was nothing compulsory about it.

The result of this experiment was better than we expected, or even hoped for. Nearly three hundred men attended the opening lecture and an average of nearly two hundred attended the entire course. At the close of each lecture an hour was devoted to a general discussion of the subject, during which questions were asked and answered. The questions asked showed the interest the men took in the subject and how closely they had followed the speaker. Our idea was that if we could interest and instruct the men employed as foremen and superintendents, the information they received would be disseminated among others as occasion might arise.

We feel that our experiment in that direction was well worth while and we are considering ways and means of extending it. I make mention of this merely to show that employees are ready, even anxious, to be educated on subjects which are of vital interest to themselves and to the companies, if only they are given an opportunity. My contention throughout is that in order to remove misunderstanding we must have understanding. I know of no way in which this can be done except by letting the employees know the facts in open, frank discussion.

In my experience in dealing with committees representing the employees I have many times observed a complete change in their attitude after a full discussion in which all the facts and conditions were laid

bare. It will not do to dismiss their demands with the short statement that they are impossible, although that may be the truth. They must be shown why it is impossible for a company to accede to their demands. If that is done in a perfectly frank manner, I have found that as a rule they are ready to listen to reason. That method may not always result in complete success, but it is always worth the effort, even though it occasionally fails.

Providing for Human Depreciation

Sometimes I feel that there is something wrong fundamentally in our present methods of dealing with the labor problem in our industry. Even on properties where there is the closest contact between the management and the men, where the most harmonious relations obtain, there is something lacking.

It does not seem quite fair to me that an employee who has spent his life in the service of the public, for that is what it means in our industry, should be cast aside without any consideration when he becomes too old to perform his work efficiently. Provision should be made for setting aside a fund from earnings, if possible, to pay old-age pensions to faithful employees, and the setting up and maintaining of that fund should be accepted by regulative authorities as a legitimate expense of operation.

We now make provision for depreciation of physical property. Why should not provision be made for human depreciation? The public would not, in my opinion, object to such a charge in the rate to be paid for transportation service.

There is another weakness in our present system which I believe should be overcome and eventually will be. To bridge the chasm which now yawns wide between the owners of a corporation and the workers who operate the properties there should be co-partnership in the enterprise. The workers should be given an opportunity to share in whatever profits there may be through stock ownership. It should be made easy for them to acquire stock in the corporation for which they work and to give them a financial interest in the enterprise, wherever the earnings of the corporation are stable enough to insure dividends.

Such a plan would go far toward removing misunderstanding and increasing the loyalty of employees. It would furnish an incentive for greater economy and efficiency on their part, as they would feel that in some degree they were working for themselves. It would give them a better idea of some of the problems which confront those responsible for the management of the properties and would, in my opinion, result in benefit to the industry.

As long as we continue to view each other across the chasm as occupants of rival hostile camps, we are certain to have occasional outbreaks of hostilities. Even when the chasm has been bridged and the human contact has been established by emissaries under a flag of truce the result is more or less in the nature of a temporary expedient. The causes which lead to conflict still remain.

Stock ownership would be a long step in the direction of removing the cause of misunderstanding and of filling up the chasm. It is a subject which I believe deserves the most careful consideration of our industry.

How Car Design Has Progressed on Chicago's Rapid Transit Lines

By H. A. JOHNSON
Assistant to General Manager
Chicago Elevated Railroads

Developments in Body, Platform and Door Design, Seating Arrangement and Interior Appearance as Dictated by Experience and Study Are Brought Out—Comfort and Attractiveness to Be Features of Latest Cars—How Reliability and Lower Maintenance Costs Have Been Achieved Is Also Told

THE original elevated line in Chicago was placed in service in 1892. The structure and stations were designed and built to use a car of approximately the same size and dimensions as was then being used on the Manhattan Elevated Railroad in New York City. As additional elevated lines were built and as all of the elevated lines operated their cars around the Union Loop in the downtown section in Chicago, it was reasonable that the physical dimensions of the stations and structure clearances should be made practically the same, so that from the beginning of the system down to the present time the same length, width and height of the cars have been maintained.

The weight of the cars has been increased on account of the first ones being trail coaches operated by steam locomotives. The structure was designed sufficiently strong to support the weight of the steam locomotives and the coaches were comparatively light weight, as low as 32,500 lb. As some of these coaches were equipped with electrical equipment and as new motor cars were built to pull two and three trail cars, the weight of motor cars increased, so that the latest type, equipped with two 165-hp. motors, weigh approximately 70,000 lb. each. On account of the restrictions imposed upon the size of the car by the structure and station dimensions, all of the developments in design since the original cars were put in service have been made in the details of the car construction, as there has been no opportunity to change the over-all dimensions.

Transition in Platforms and Doors

The cars as originally constructed were equipped with open platforms on each end and with one door in each bulkhead. The entrance and exit to the platforms was controlled by iron gates approximately 26 in. to 28 in. in width. The next general step in the arrangement of the platforms was to maintain the bulkheads in the ends of the cars with bulkhead door, but to vestibule the platforms, using full length wooden doors of approximately the same width as the iron gates. The next

Type of modern steel car now in use on Chicago Elevated Railroad

general step in advance was to build a fully inclosed car with the car body and the vestibule together, omitting the bulkhead. At each of the four corners of the car there was installed a door sliding back into a door pocket and controlled with an air engine. The width of this door was slightly increased, changing the door opening from 26 in. and 28 in. to 36 in.

The next cars maintained this same general type of construction, except that the width of the four sliding doors was increased from 36 in. to approximately 48 in. This was the arrangement of doors when the first steel cars were designed in 1913. At that time it was anticipated that there might soon be a subway in the city of Chicago, and in that case very heavy passenger loads would be concentrated at a few stations. The steel cars were designed to be suitable for the proposed subway operation, and accordingly were provided with sliding doors at the center of the car as well as at each end, making three doors on each side of the car instead of two. The width of the center door was maintained at 48 in. and the width of the four end doors was reduced from 48 in. to 44 in. These cars were equipped with longitudinal seats, as it was considered that the center doors would soon be put in operation.

A year later an additional number of these steel cars were put in service, built on the same plans with the center door installed, except that reversible Walk-Over seats were installed at the center portion of the car with longitudinal seats at the four corners. As the center doors had not been used in any of the steel cars and as the tendency in the city of Chicago was to change from longitudinal seats to cross-seats it was necessary to install the Walk-Over seats in the second lot of steel cars to meet the wishes of the public. We still thought, however, that the center doors would some day be used, and so the doors were installed in the sides of the cars with the understanding that when they were placed in operation the cross-seats set in front of them would be removed and longitudinal seats substituted.

Standard seating arrangement and interior appearance of steel "L" cars

During the last few years the traction situation in Chicago has developed along lines which indicate that center side doors in the elevated cars will not be needed for a good many years, and as the public much prefers the cross-seats to the longitudinal seats, and as the installation of these seats across the center door does not afford the same comfort and convenience to the passengers that the seat installed opposite the regular car window affords, the management decided that on the 100 new elevated cars which are now under construction the center doors would be omitted. The steel framing of the car, however, has been designed in such a manner that center doors may be installed at a later date at a minimum cost.

Progress in Seat Arrangement

The original coaches placed in service on the elevated roads had four stationary cross-seats at the center of the car with longitudinal seats throughout the remainder of the car. This seating arrangement was maintained in the coaches for a good many years. When electrically operated motor cars were first installed, they were equipped with longitudinal seats throughout. This condition existed a good many years until finally all motor cars were equipped with the four stationary cross-seats at the center of the car and longitudinal seats for the remainder, the same as the original coaches. This arrangement was maintained until the sentiment for the cross-seats became so strong in Chicago that these were installed on all new equipment. A short longitudinal seat at each of the four corners of the car is used with the

cross-seats to provide a well near the end doors of the car. With the exception of the return to the longitudinal seats on account of the center doors installed in the first steel cars built in 1914, the plan has been to install all cross-seats in all cars. Seven reversible seats were first placed on each side of the car, then eight, and in the new cars now being constructed there will be nine.

From the commencement of the elevated roads down to the present time it has been the general practice to use canvas-lined rattan as upholstering material for all seats. The seats for the new cars, however, will be upholstered with green plush of the best grade. This step is being taken to please the passengers, as plush upholstered seats are more comfortable and have the appearance of greater luxuriousness.

Car Framing and Flooring

The original cars on the elevated roads were built entirely of wood. The next step was to introduce a partial steel subframe in addition to the wooden subframe. This was followed by cars built with steel subframes and steel and wood cars were introduced in the elevated service. The cars which are at present on order will be of all steel design with several modifications over the cars built in 1914 and 1915. For instance, a double wooden floor will be installed instead of the composition floor used in the earlier steel cars. The wooden floor is warmer and has a much longer life than the composition floor. A great deal of complaint has been received from patrons, since the original steel cars were placed in service, on account of the coldness of the composition floors. Although these cars are the best heated cars on the system we are unable to keep the floors warm and it has been necessary to install leather floor mats during the mid-winter months. The wood floors will overcome this criticism as well as last longer and be cheaper to maintain. The wood floor has been fireproofed by the installation of a sheet steel subfloor as part of the steel underframe of the car.

The first steel cars were equipped with steel roofs, and these cars have been operated only on tracks where third rail was installed. But the new cars will be operated partially over tracks where overhead trolley wire is installed. Hence it will be necessary to equip them with overhead trolley devices as well as third rail devices.

The underframing and steel under-floor of Chicago Elevated steel cars

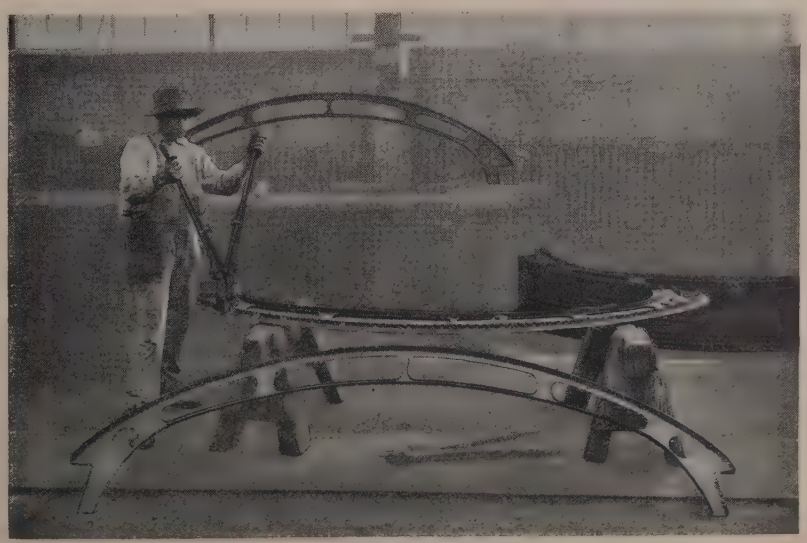
As serious consequences might result from a trolley wire falling upon the steel roof of the passenger car, it was thought advisable to protect the roof against this contingency. It was decided to install a wood and canvas roof which would provide the proper insulation. Steel carlines and steel headlining will be installed and connected to the steel side structure of the car so that the interior of the car will be fireproof from without.

On the first lot of steel cars the entire interior finish was made up of steel or Agasote. The cars which are now being built will be trimmed with steel, Agasote, and, in some places, mahogany. The mahogany will be used for arm rests, post covers and in a few other places which come into more general view of the passengers. It is considered that mahogany will present a better finish and a more pleasing appearance to the passenger than the steel and Agasote, the idea being to produce the most attractive car possible as one step in merchandising the service.

Motor and Trailer Practice Largely Followed

The original motive equipment on the elevated roads consisted of steam locomotives hauling a number of trail coaches. After these steam locomotives had been in service for a few years on the South Side and Oak Park roads the Metropolitan Elevated was constructed and started in operation with electrically operated motor cars used as locomotives to haul one, two, three and four coaches. A few years later the steam locomotives on the South Side Elevated were abandoned and multiple-unit motor cars substituted.

The next step was to install multiple-unit control equipment on



Pressed steel carlines for arch-roof steel "L" cars

all of the roads. The South Side still maintains all motor cars while the other roads equipped their motor cars with large motors and operate trains composed of motor cars and trailers. The tendency has been to maintain a train make-up of motor cars and coaches, with the motor cars equipped with two motors of approximately 165-hp. capacity. As there have been more coaches in service than there were motor cars, the tendency is also to increase the number of motor cars so as to increase the motor capacity per train, which will result in faster acceleration and better schedule speeds. Accordingly the new cars which are now under construction will be motor cars.

Trucks Improved for Riding Qualities and Wear

The construction of trucks as used on the elevated cars has been considerably improved from time to time. This has been done mostly by making a close study of all parts which have caused failure or have rapidly worn, to terminate the cause and make such changes or redesign the parts in such a manner that the failure or rapid wear would be eliminated. By improving one detail after another the trucks as now used have been developed to the highest point of reliability. They are entirely free from trouble outside of the replacement of usual wearing parts. All of these wearing parts have been equipped with case hardened wearing shims to reduce the wear to a minimum, and these shims are installed in such a manner that when they do require renewal they can be changed with a minimum amount of labor and time. Although considerable attention has been given in years past to the spring arrangement and riding quality of the trucks under our elevated cars, no particular advancement had been made on account of the limited space for springs, occasioned by structure clearances and the size of the motors installed in the trucks. The trucks for the new cars which are now being built, however, have been redesigned to make more room for the springs so that more flexibility can be provided. The whole spring arrangement on these new trucks will be approximately 10 per cent more flexible than the springs on previous trucks. This will make them easier riding and more comfortable for passengers.

The first cars on the elevated system were equipped with straight air brakes. From that time we have progressed with the general advancement in the art and installed quick-action automatic brakes, then quick-action graduated release automatic brakes, and finally, the universal type of air brake.

For years the mechanical department of the elevated roads of Chicago has devoted a large proportion of its time to the details of equipment failure which caused delays on the road, necessitated sending cars to the shop and required the replacement or renewal of parts. In the case of any part which was giving an undue amount of trouble, whether it was a spring in the door latch, a bolt in the motor frame, or some part of the control equipment, a careful study has been made to find out how to increase the life of that particular part, or eliminate it entirely by redesigning a new part. In many cases a better grade of material has solved the problem. In other cases the parts have been redesigned or reconstructed, or the wiring of some piece of electrical apparatus changed, or the part eliminated entirely.

During the last few years one after another of these troublesome details have been corrected and all during this time the reliability of the equipment has been steadily improved. All such changes which have been found necessary have been incorporated in any new equipment which was purchased. This has applied to all parts of the equipment whether it be control equipment, motors, trucks, air brake or car-body parts.

By the time the steel cars were designed and built in 1914 and 1915, so many of these detail troubles had been overcome, and the design of the various parts of these cars relating to each other was so carefully gone into that when the cars were received they went into operation and performed in regular service without any difficulty whatever. It was not necessary to put them through a period of breaking-in, as is often done.

During the seven or eight years that they have been in service the results have fully met all expectations. The car-mileage per delay on these steel cars is several times as much as the car-miles per delay on the old types of equipment. However, such troubles and conditions as have developed on these cars in service will be corrected in connection with the cars now being built, so that as far as reliability is concerned the new cars should be even better.

Maintaining the Chicago "L" Structure

By G. M. ANDERSEN
Engineer Structures and Buildings
Chicago Elevated Railroads

THE oldest structure of the elevated railroads in Chicago was built some thirty years ago of wrought iron. The later structure was built of low carbon structural steel. The structure is inspected twice a year and records of these inspections are kept on a form sheet. These inspections are made by a structural iron worker and an assistant and are very thorough. All defects, such as loose rivets, etc., are recorded and are followed up and repairs made by the structural iron gang. It is interesting to note that wrought iron has much greater resistance against corrosion than structural steel. Wrought iron in this respect acts very much like copper bearing steel; it rusts on the surface but does not pit.

The painting of our structures is done on a seven-year program. It has been found that seven years is the maximum protection we can get in this climate with a good grade of paint. This does not, however, apply to locations where the structure is subjected to unusual conditions, such as gases, etc., where it is necessary to do painting every two or three years. Tests are carried on in these bad locations in order to determine the merit of paints. The painting work is generally done by our own forces, although some of it is let out by contract. The standard paint used on our structures is made up from

our own specifications and consists of two parts of Double Label Prince's Metallic, one part red lead and one part graphite. This pigment is ground in 25 per cent of its own weight in raw linseed oil and then reduced with linseed oil to a liquid consistency, weighing 13 lb. per gal.

Many of our structures run over alleys or back streets. These alleys are also used or rather mis-used by the neighbors as dumps for ashes and garbage. Consequently the surface of the alleys grows higher and covers our column bases. To protect these column bases has been quite a problem, but this trouble has been successfully overcome by covering the column bases with concrete 1 or 2 ft. above the foundations. This concrete is built directly on the column base and in this way moves with the column and is really a part of it. A slight movement in the column will thus not crack the concrete. Light woven wire reinforcement against cracking is also used.

The present-day designer of an elevated structure can obtain valuable information by a study of existing structures. Ample and proportionate strength, ease of manufacture, ease of erection and cost are the main features to be considered. The very important item of maintenance was given very little thought in connection with the design of present structures. My advice to designers is to keep clearly in mind that ultimate cost is more important than first cost.

Signaling Trains on Chicago Elevated Railroads

By J. W. STEPHENSON
Signal Engineer
Chicago Elevated Railroads

SOME of the most recent developments in connection with the protection of train movements on the Chicago Elevated Railroads are the installations at bridges. The signal systems on the new Wells Street Bridge and the Lake Street Bridge are practically identical. These are the result of experience extending over a period of years. The old drawbridges were replaced by modern double-deck trunnion bascule-type bridges. It was found possible to eliminate one tower and operate both sides of the interlocking from one shore, effecting a saving of one towerman. This is done by controlling the far side through a submarine cable and by the use of track circuits. The plant is electro-pneumatic throughout. Alternating current is used to eliminate interference by d.c. propulsion return. In addition to the automatic stop at home signals, a diverting or bumping post switch has been added to insure a stop in case a motorman runs by the home signal.

A special feature developed for these bridges is the circuit control contact boxes which insure that all railbreaks are in place and properly aligned. Should any railbreak be out of line the contactor remains open and the indicator relay in front of the towerman will not clear. Neither will it give current to release the master control lever in the machine, which in turn will not give power to operate the bridge locks and motors. In other words, the control, locking and signaling of the bridge are all interlocked and backlocked so that the operator cannot make false moves. Everything must be done in sequence and all apparatus must be in proper place.

Block Signal System Being Systematically Extended

There are of necessity many curves on the elevated railroads. These are being protected according to a fixed program by means of three-position color light signals. Alternating-current single-rail track circuits are in use, and have proved highly successful. When a curve is to be protected, a speed-time curve is made up to suit the headway of trains, and the speed allowed over a given curve. Allowance is made for growth of traffic. When signal locations are made, taking into consideration braking distance and motorman's view, the general superintendent checks the locations, giving the signal engineer the benefit of years of experience on the front end of trains. Thus the installation may be classified as "tailor made" rather than "ready made."

The busiest railroad crossing in the world is at the intersection of the Chicago Elevated Railroads at Lake and Wells Streets. In the hour of maximum travel on the elevated, 218 trains comprising 1,100 cars pass this corner, or at the rate of 3.6 trains per minute averaging five cars per train.

Methods of Inspection Followed

In making new signal installations, brackets for signals are set in place, track bonding, alternating-current leads and meters are installed, and signals, relays, wiring and housings placed by the signalmen. All work is so co-ordinated that when tests are made and approved, the transportation department immediately gets out its bulletin and within the next twenty-four hours the signals are in service and the investment is making money for the company, not only by protection of trains, but in added track capacity.

The main object of inspection is to catch trouble before it happens. First of all, we depend upon the signal maintainer, who is closer to his plant than any one else. A weekly interlocking inspection report is filled out by him every Saturday and sent to the signal foreman. Each month the signal foreman and track foreman make a joint inspection of interlock plants and insulated rail joints. A written report goes to the engineer maintenance of way.

Twice a year, in the spring and fall, the signal supervisor makes a detailed inspection of all interlocking plants and block signals. His report is made to the engineer of maintenance of way, with copies to the signal engineer and general foreman of the respective roads. The general foreman turns over the findings to his signal foreman, and he in turn to his maintainers, who correct defects and carry out recommendations, reporting back when completed. Then all reports are collected and sent back to the engineer of maintenance of way, where they are checked and filed for reference on the next seasonal inspection. This entails considerable work, but recurrent troubles are kept at a minimum and the failures as plotted show a steady decrease.

All failures are thoroughly investigated. No unsolved mysteries are allowed to stand, as it has been our experience that there is a determinable cause for all failures.

How "L" Track Is Built to Handle 900,000 Cars a Year

By H. P. SAVAGE
Track Engineer
Chicago Elevated Railroads

New type guard rail on Chicago Elevated curve in the foreground with old type in the background

THE problems of maintaining the tracks on a system of this kind are many. Probably the greatest problem is to get special work and rail of a suitable nature to withstand the great frequency of train operation. The 4.72 miles comprising the Union Loop is divided into 2.36 miles of track known as the Inner Loop and 2.36 miles of track known as the Outer Loop. Over each of these two tracks during the course of one year, 900,000 cars pass. Originally the track construction on the Loop was the same as elsewhere on the elevated lines—No. 1 yellow pine ties placed at 18-in. centers with 80-lb., 33-ft. open-hearth A.S.C.E. rail. This was changed about 1911. The ties were placed much closer together, the centers being 11 in. instead of 18 in., making almost a solid bed of ties. The rails were replaced with 60-ft., 90-lb. high-carbon open-hearth rail. The special work, that is, the frogs and switches, were all changed to 90-lb. rolled manganese rail with heavily sideguarded switches. With this new construction the life of the track has considerably lengthened, and the life of the switches has been increased from ninety days to two and a half years.

On the lines adjacent to the Loop where the volume of traffic is also very heavy, it has been necessary to rearrange our standards and use 90-lb. high-carbon open-hearth rail, A.S.C.E. section, larger tie plates beveled one in forty, apply anchors in the center of each rail, use high-carbon heat-treated angle bars with heat-treated track bolts, and joint screw spikes to hold the rail from creeping or minimize creepage. We have 947 switches and eighty crossings, and 20.62 miles of the total 190.03 miles is curved.

The ties used on the elevated structure are 90 per cent heart, or better, long-leaf yellow pine. These are untreated, as we find that they wear out by abrasion before they rot. The life of the ties is from fifteen to eighteen years on tangent and twelve to fifteen years on curve track, depending largely on traffic. We use white oak and treated red oak ties on surface tracks.

We use a high-carbon 90-lb. rail on tangent and on long, radius curves. This was found necessary on account of the frequency of traffic which will rapidly cold roll an ordinary open-hearth rail. The carbon runs from 0.75 per cent to 0.88 per cent. Rail on tangent lasts about fifteen to eighteen years, depending on traffic. It fails by the joints cupping. In many cases we have taken out rail, sawed a foot off each end and relaid.

MILEAGE OF CHICAGO ELEVATED SYSTEM

Road	Elevated	Surface	Total
Metropolitan	43.04	11.70	54.74
Northwestern	47.39	14.22	61.61
South Side	42.49	3.81	46.30
Oak Park	16.30	6.36	22.66
Union Loop	4.72	.....	4.72
Totals	153.94	36.09	190.03

This can be done for about half the cost of new rail. On curves of shorter radius we use rolled manganese, as we have found it to outlast the open hearth by about 8 to 1. Rails fail on curves due to corrugation.

All curves are measured and made up by a special gang of five men, which has its headquarters and equipment at one of the yards. The equipment consists of a big bulldozer strong enough to bend a 100-lb. rail head on, drill presses, rail punches, rail saws and overhead carriers.

Footwalk renewals are made up in 16-ft. and 18-ft. sections in the yards and are placed with a derrick car.

When tie renewal becomes necessary at any point, the deck is renewed completely for long stretches; that is, there is no spotting of ties or patching, as we have found that this gives a very bad track on account of uneven bearing. Ties are not countersunk for rivets but are allowed to set down from the weight of the trains. Electric tools for boring are used extensively. Countersunk holes in guard rail are filled with mastic asphalt. Renewals of deck are made under traffic on six-minute intervals. Closer interval track is cut out.

Curved rail is laid with traffic cut out. Tangent rail is hooked up in long stretches and thrown in with traffic cut out. All track is patrolled once a day by section men. Curves are greased with heavy graphite grease as frequently as needed.

We have found that wooden plank will not stand up under the heavy traffic that we get at our surface crossings and are therefore using Tarvia, concrete and concrete plank with good success.

Utility Insurance an Exacting Science Now-a-Days

By WILLISTON FISH
General Manager Chicago Surface Lines

IN THE good old days any man by demonstrating — fully — that he was good for nothing else was held to have demonstrated—fully—that he was born for the insurance business, and when, thereupon, he got in some blank policies and put out a sign he became an ordained insurance agent, and any property owner who was a personal friend of his would immediately and naturally rely upon him implicitly, in insurance matters, for advice and guidance.

Certainly it was a happy time when no man needed to be disheartened by failures in business or by being derailed in his chosen lifework, understanding that when his failures were sufficiently numerous and complete he would be ready to act as a trusted counselor in every branch of insurance, and grab off the regular commissions, do well and be highly regarded in the community.

And the old times were happy times not only for the insurance broker but also for the public utility manager, who then could "give the insurance" to his personal friends and be a tremendously good fellow, or "divide the insurance" among the agents in the territory and be a tremendously politic fellow. This satisfaction of the management was supposed to be gained without any cost, it being assumed that insurance agents had no other function than to sign policies and collect commissions, and that when once signed one policy cost no more and no less than another and served the purpose no better and no worse.

Simple, happy Arcadian days—sometimes, of course, sadly interrupted by discovery that a public utility company had been wasting money for years by paying premiums on account of hazards that could have been cheaply eliminated, or more sadly interrupted, after fires, by the shocking discovery that values had not been properly estimated or that they had materially changed or that the insurance form had not been properly drawn or that guaranties had not been kept or that responsible insurance companies had not been chosen. But on the whole, simple, happy Arcadian days.

Providing full protection with the lowest possible expenditure requires systematic and experienced handling. The system in use by the Chicago Surface Lines and the reasoning which lies behind it are succinctly and interestingly told

However, they are days that are gone. Various causes have combined to bring about a radical change in the whole attitude of public utilities toward insurance. Some of these causes are indicated below:

WHY UTILITY INTEREST IN INSURANCE IS INCREASING

1. The utility properties have greatly increased in size and importance, and each department of the business receives closer and better attention. A large utility company's insurance is no longer held in the hands of the head men as a mere matter of patronage, nor is it turned over to the least occupied clerk as mere matter of form and record.

2. Utility rates are made by commissions, and it is understood that fair rates include the reasonable cost to a utility of full insurance protection.

3. As a development beginning about 1900 there has been an enormous advance in the art and practice of valuation so that there has come to be a far better understanding by the management of utilities of the values of the various items of their properties.

4. Since 1914 the great and rapid rise in cost of labor and material has roused companies to inquire more carefully and more frequently into their insurance valuations, and at the same time the increasing premiums based on increased valuations have led managements to inquire how rates may be reduced.

5. A shortage of plant and equipment to meet increasing demands of service has led managements to study fire protection and fire insurance.

6. The increased care of trustees under utility mortgages to see that the provisions of mortgages include ample insurance protection, and that these provisions are carried out, has been an important factor in bringing about an improved insurance situation.

7. Especially there has grown up, with the rapidly increasing operating factor, a vivid realization of the need of care and economy in the administration of each department of each public utility.

8. During a course of years, beginning perhaps around 1900, insurance brokerage concerns have been very highly developed so that they have become capable of giving the wider, wiser, fuller and more scientific service and the all-the-year-around service that the magnitude of the property interests involved and the demands of modern management have gradually come to require.

The *Electric Railway Journal*, understanding the great and growing importance of the modern subject of insurance, wished to give space to the matter in its Convention Number, and out of courtesy it has asked the Chicago Surface Lines, as one of the representative members of the association in the convention city, to furnish a statement setting forth the manner in which its insurance is now handled. The Surface Lines is very willing to furnish the statement, but of course with the understanding that it is speaking only among friends and fellow mem-

bers of the association and is not attempting to pose as an instructor or as an authority or guide in insurance.

How Chicago Company Follows Insurance Detail

The Surface Lines plan of caring for insurance and fire protection—two matters which are inseparable—includes the following:

1. A detail inventory and valuation is made of all insurable property. The valuation is based on present reproduction cost new, with depreciation therefrom figured on sinking fund basis. From the detail inventory and valuation there is made up an abridged volume which shows each separate insurance risk with reproduction cost new and depreciated values of the main items making up the risk. The figures for non-insurables are shown and deducted. A copy of this volume is furnished to our general insurance agents.

Redeterminations of insurable values are made each insurance year, or oftener, when necessary to meet changes in base costs.

2. The general insurance agents cause to be made up by their insurance engineers a complete insurance survey and report of all buildings, yards and insurance locations. The report gives a plat, description and study of each separately rated risk. Among other things, it shows the insured values at each such risk in building, contents and rolling stock, respectively; the make-up of the rate on the risk, the cost in premium due to each item of the rate, a discussion of the improvements that could be made in each separate risk, with resulting premium savings; suggestions for eliminating fire dangers or providing for better protection against fire in cases in which rate and premium are not affected.

3. The Surface Lines departments concerned are furnished with copies of the insurance survey and report. These departments make studies and estimates to determine what improvements among those suggested are feasible, the best way of carrying them out and the probable cost. Each case is then considered and decided—the estimated cost of the improvement being set against the saving in premium, the lessening of fire risk, etc.

4. All of the Surface Lines properties are inspected regularly by experienced and capable insurance engineers furnished by our general insurance agents. Our own forces maintain a constant supervision over the risks to see that our guaranties are maintained, that fire-fighting apparatus is kept in place and in condition, that automatic doors are kept free and in operating order, that no new fire risks are introduced without authority, and generally that "good housekeeping" is maintained.

5. Designs for new buildings or for building changes are submitted to our general insurance agents for suggestions looking to maximum fire safety and minimum rates.

6. We have appointed Marsh & McLennan to be our general insurance agents and we have placed upon them, and in the regular course of their business they have assumed, full responsibility for all the above work except the making of inventory and valuation and the estimates of costs of improvements, and our own inspection.

Some of the Company Practices in Fire Protection

Nearly all our carhouses are fireproof or fire-resistive construction. We have several operating car storage yards with bays divided by fire walls. Our aim is to give bays in carhouses and yards a maximum trackage of 1,500 or 1,600 ft. so as to limit the loss of rolling stock in case of a fire to the equivalent of about thirty double-truck cars.

All our properties of any size are equipped with central station watchman service, standpipes and hose, barrels of water and buckets, sand pails and chemical extinguishers. Fire apparatus is painted red.

Our men are drilled at short intervals in fire fighting. Call to drill is by gong sounded at any time night or day. On the sounding of the alarm all the men at the car station or shop accustomed to handling cars hasten to move the cars out and to a proper distance away. The rest of the men run to their places to make use of the fire-fighting apparatus. In case of actual fire the first man to discover it turns in the alarm for the public fire department and then the call for the company brigade. At all locations Chicago fire alarm boxes are close by. For a considerable time past the calls of our employees in cases of actual fire and the responses of the Chicago Fire Department have been almost or altogether perfect.

The average total cost of heating the cars of the Chicago elevated railroads is $166,800 per year. The energy consumed in heating is 10.65 per cent of the total energy used by the system.

In the construction of our cars we require that the wiring and the car heaters be installed according to the National Electrical Code. At car stations we allow smoking in crew rooms only. We have the hearty cooperation of trainmen and other employees in the work of good housekeeping and safeguarding the properties against fire. Our stations designed since 1907 afford track facilities for getting out rolling stock in case of fire. Where practicable the bays are double-end.

Constant Attention Needed to Keep Utility Properly Insured

Our total fire insurance is now something over $55,000,000, nearly all of which is carried on one general blanket form with a 100 per cent co-insurance clause. This form is of course carefully drawn under the advice of our general insurance agents, with the approval of the legal department and of other departments of the Surface Lines that are concerned.

We understand that fire insurance is a science; that it consists of many items, none of which may be overlooked without penalty great or small. We give constant attention to our insurance ourselves, but we demand and obtain from our general agents unlimited, all-the-year-around service. We feel that our insurance is safe. We feel that we are getting good results in (1) reduction of rates and (2) protection of our income by minimizing fire risks. During the last twelve months, with the services of our agents and under the plan above outlined, an annual premium reduction of over $50,000 was effected, and other improvements suggested in the survey and report of the agents will give us a considerable further reduction. The cost of the improvements necessary to secure these reductions will hardly exceed the premium savings for one or two years.

It is to be expected that the importance of the subject of insurance of various kinds, and the attention that public utilities are now giving it, will effect highly valuable improvements in general and also in detail.

But of course the old, simple, happy Arcadian days are gone.

Systems and equipment used in Chicago were determined upon only after extended study and tests, the results of which are here presented for the first time, together with the experience in various phases of this perplexing problem

Heating and Ventilating Chicago Street Cars

By CHARLES GORDON
Engineer of Equipment
Chicago Surface Lines

Standard exhaust and intake automatic ventilator installation as installed on monitor deck Chicago car

THE subject of heating and ventilating of street cars has become an increasingly important problem to the managements of electric railway properties as the industry has progressed. At one time a layer of straw on the car floor was considered a satisfactory provision for the comfort of urban passengers. The introduction of stoves represented the first serious attempt at providing artificial heat, while ventilation was obtained through the deck sash provided in the deck roof construction. This was carried over into street car design from coach practice.

The necessity for more scientific methods of ventilation has been a development incident to the demand for better heated cars. Before the advent of the inclosed vestibule, car heating practice, although it had developed to the stage of providing a source of heat within the car, did not even attempt to maintain any given temperature. So much cold air was admitted around doors and crevices that there was no particular demand for ventilation. Deck sash were provided which could be opened when the car became "stuffy" due to rising outdoor temperature or an extremely crowded condition.

With the advent of the inclosed vestibule and the demand for better heating facilities and higher car temperatures, the problem of ventilation, considered from the standpoint of passenger comfort, may be said to have really taken concrete form. The two subjects are inseparably associated and are both of importance only in the winter when the windows are closed and the heat turned on.

Problems of Ventilation Physical Rather than Chemical

Before proceeding to a description of a number of the studies which have been made in Chicago, it may be well to summarize briefly some of the general principles connected with the subject, upon which there was for many years a general misconception among those generally regarded as authorities, and there still is in the popular mind.

After a great deal of exhaustive research on the part of many investigators, it is now generally agreed that the problems of ventilation are essentially physical rather than chemical. In attempting to provide for the comfort of passengers in a street car, therefore, through the design of a system of ventilation, it must be borne in mind that the feeling of comfort engendered by the quality which is generally referred to as "freshness" in the air within the car results from the physical contact of the air with the skin and the psychological reaction from the effect on the sense of smell, rather than from any chemical result through respiration.

Unless the air in contact with the skin is of proper temperature and humidity and is in a sufficient state of motion effectively to absorb the required heat and moisture from the body, the passenger will be uncomfortable regardless of the chemical purity of the air. Conversely, with the temperature, humidity and state of motion of the air properly controlled, a person may remain in an atmosphere containing a relatively

large percentage of the products of respiration without feeling any discomfort whatever.

These facts have been amply demonstrated by many investigators. The early theories which assumed that ventilation systems should be designed for the purpose of eliminating the so-called harmful and poisonous products of respiration have been ably and conclusively disproved. Although the carbon dioxide content of occupied spaces is still used as an index of the quantity of air supplied to the breathing zone, it is in itself no longer considered a harmful ingredient of the air, even when present in quantities far in excess of that obtained in crowded spaces where little air supply is provided.

In attempting to provide a satisfactory combination of heating and ventilating, the car designer and operator, working under the general misconception of the subject, were faced until comparatively recent years with an almost impossible combination of requirements. The entire efficacy of the ventilating system was judged on the basis of volume of air admitted to or extracted from the car, and the success of the heating system was judged on its ability to maintain a given minimum temperature without regard for limitation against excessively high temperature. Where electric heaters were used this practice resulted in a needless waste of heating energy. In addition, when sufficient heating capacity was installed to maintain a comfortable temperature in severe weather, a moderate day would produce extremely "stuffy" cars, which seemed to require larger volumes of "fresh" air to be provided by the ventilating system. Where an attempt was made to avoid needless waste of heating energy by providing heater capacity suitable for average temperature conditions only, an unusual cold spell would result in poorly heated cars. By providing means for automatically controlling the car temperature, by giving more attention to the methods of producing the required air interchange so as to give a degree of dilution which would rapidly dispel odor and at the same time create a condition of motion of the air within the car without producing objectionable drafts, and by introducing and diffusing sufficient quantities of "fresh" air at a point near the roof in such a way as to give the stimulus of cool air in contact with the skin, a great deal of progress has been made in perfecting a combination of satisfactory apparatus for heating and ventilating of street cars.

The above résumé of the underlying principles involved is presented not so much for the purpose of reviewing the subject, but for the purpose of outlining the point of view from which the task of properly heating and ventilating street cars in Chicago has been approached.

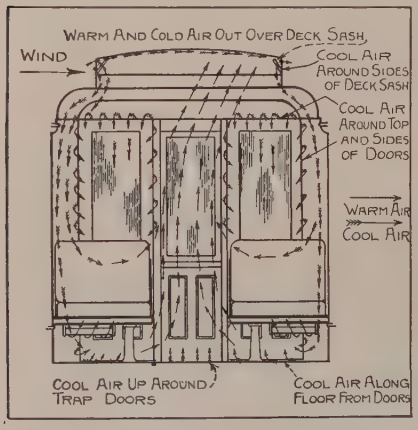

WARM AND COLD AIR OUT OVER DECK SASH
WIND
COOL AIR AROUND SIDES OF DECK SASH
COOL AIR AROUND TOP AND SIDES OF DOORS
WARM AIR
COOL AIR
COOL AIR UP AROUND TRAP DOORS
COOL AIR ALONG FLOOR FROM DOORS

Fig. 1—Monitor deck car, deck sash open, cross wind blowing.

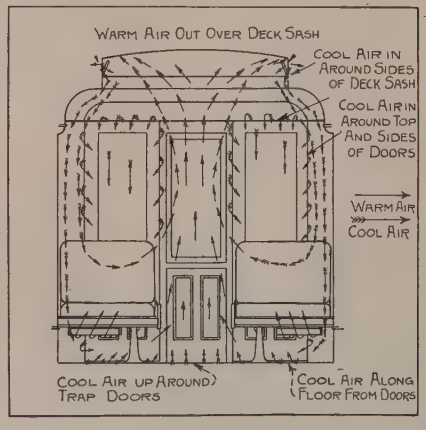

WARM AIR OUT OVER DECK SASH
COOL AIR IN AROUND SIDES OF DECK SASH
COOL AIR IN AROUND TOP AND SIDES OF DOORS
WARM AIR
COOL AIR
COOL AIR UP AROUND TRAP DOORS
COOL AIR ALONG FLOOR FROM DOORS

Fig. 2—Same as Fig. 1, but no cross wind.

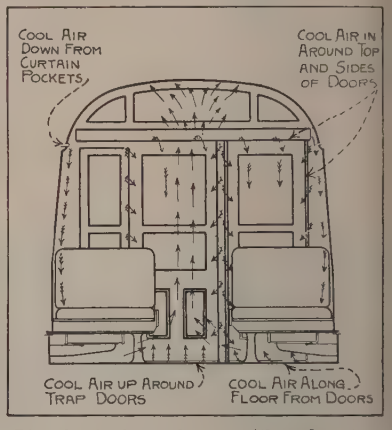

COOL AIR DOWN FROM CURTAIN POCKETS
COOL AIR IN AROUND TOP AND SIDES OF DOORS
COOL AIR UP AROUND TRAP DOORS
COOL AIR ALONG FLOOR FROM DOORS

Fig. 3—Arch roof car with exhaust fan ventilation, no wind.

Air circulation in cars standing with electric heaters on

REQUIREMENTS SET UP FOR CHICAGO COMPANIES

The ordinances of the city of Chicago contain the following requirements relative to the heating and ventilating of cars:

A minimum temperature of 50 deg. F. above zero shall be maintained in all cars in service carrying passengers when the outside temperature is at 10 deg. F. above zero or higher.

A minimum temperature of 45 deg. F. above zero shall be maintained in all cars in service carrying passengers when the outside temperature is below 10 deg. but not below 5 deg. F. above zero.

When the outside temperature is below 5 deg. F. above zero, the temperature in all cars in service carrying passengers shall be maintained at 45 deg. F. above zero, or as near this point as the continuous operation of all the heaters in said car to their full capacity will allow.

There shall be maintained and conspicuously displayed in such car a standard Fahrenheit thermometer so located that it will furnish a fair criterion of the temperature of the car.

The air shall be supplied in such quantity that the amount of carbon dioxide present in the air of the said car shall not exceed twelve parts in each 10,000 parts of air.

Electric heaters became standard equipment on all surface cars in Chicago during the rehabilitation of the property after 1907. Their use was dictated primarily by their cleanliness and the resulting reduction of fire risk. Ventilation at this time was entirely by the use of deck sash. On some of the first groups of cars constructed during the rehabilitation period, a simple type of intake was installed in the front deck opening, arranged with deflectors to exclude weather and registers on the interior of the car to regulate the quantity of air admitted. This was a long step in advance, but in service these intakes were generally kept closed because they produced objectionable drafts when the car was operating at full speed.

Tests of various forms of ventilating devices were conducted from time to time, beginning about 1908 and extending through 1909, by the engineers of the street railway companies, co-operating with the Board of Health of Chicago and the Board of Supervising Engineers. These tests were carried out upon various types of "natural exhaust" ventilators installed in the monitor decks,

with openings for intakes arranged in various ways, usually in the floor of the car, and designed to supply outside air in proportion to that eliminated through the ventilators.

The various ventilators were compared on the basis of the results obtained from anemometer readings taken at the exhaust openings. In the progressive study of this subject, tests were also conducted upon cars equipped with the "vacuum system" of ventilation, in which a duct was provided along the ceiling of the car opening through registers into the car body, and from which the air was exhausted through a blower fan placed in a housing on the hood and opening into the duct through the end of the deck.

Depending only upon the size and speed of the fan, the tests of this system showed it to be capable of circulating almost any quantity of air desired. A group of 350 monitor deck cars was therefore equipped by building a false ceiling in the deck to provide a duct, allowing the deck sash to be operable if they should be required.

Numerous tests showed that this system would exhaust considerably larger quantities of air than was possible with the best of the various forms of "natural exhaust" ventilators available up to this time. As the sole criterion of good ventilation at this period was generally considered to be the number of cubic feet of air exhausted per hour from the car, the railway companies in Chicago looked upon this arrangement as a means of providing the large volume of air exhaust desired and at the same time permitting the elimination of the heavy and expensive monitor deck through the use of the lighter and cheaper arch-roof construction for cars.

As a result of these conclusions, the next groups of cars built were of the arch-roof type and included the "vacuum system" of ventilation. In the early installations it was considered necessary to provide special intake openings for the admission of air to supply that exhausted by the fan system. These openings at first consisted simply of holes cut into the floor, usually under either the cross-seat or longitudinal seat heaters or both. These openings were later inclosed by ducts so as effectually to conduct the incoming air around the heater before it was admitted to the car. Experience with this arrangement soon demonstrated that an objectionable quantity of dust was drawn into the car, and later constructions provided for the admission of incoming air through louvers in the side of the car body between the sill and the belt rail. This arrangement was an improvement from the standpoint of eliminating excessive entry of street dust.

The "vacuum system" in service developed certain disadvantages, among the most important of which were the following: (1) High first cost; (2) noise; (3) necessity for maintenance of a motor-driven fan equipment; (4) necessity of supervision of operators to make sure ventilating fans were kept turned on; (5) large quantity of air exhausted when comparatively light passenger load is present in car, thus resulting in needless waste of heating energy.

Nevertheless, it was at this time the only practical method of obtaining the large volume of air interchange which was considered the primary requirement for satisfactory ventilation. In addition, it seemed to be the only means of providing any suitable ventilation with the desirable arch-roof construction.

Although up to this period many tests had been conducted on the monitor deck cars, in an attempt to find a better method of providing ventilation than that obtained by opening the deck sash, no system which would give a real improvement had been found. In the progress of these tests, a large number of readings on various cars in service during the rush hour were taken, both on cars equipped with ventilators and those equipped with deck sash only. The quantities of CO_2 obtained during these checks were not found excessive in the monitor deck cars without ventilators, when the deck sash were kept properly open, but these cars were generally unsatisfactory because of objectionable drafts produced in cold weather and the consequent difficulty in keeping the sash open.

The City Health Department cooperated with the engineers of the railway company and the Board of Supervising Engineers in a careful study of the subject, and it was finally decided that the results obtained with a properly designed natural exhaust ventilator would result in a sufficient improvement in the conditions to warrant the expense of installing ventilators of this type in all of the then existing monitor deck cars. During the progress of these investigations, Dr. E.

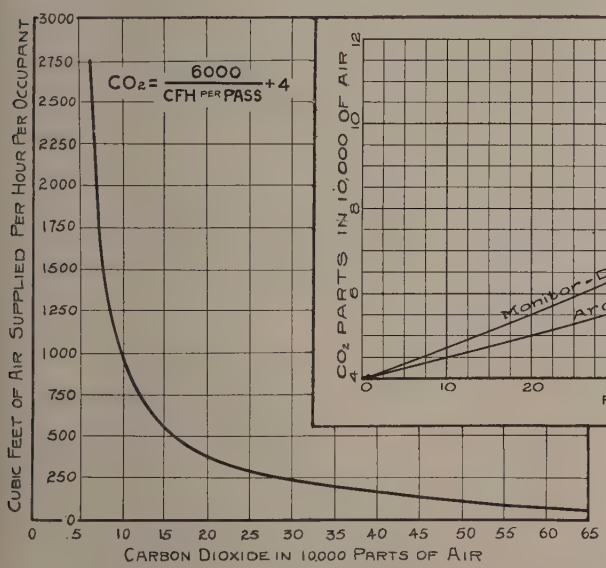


Fig. 4. (left)—Relation between CO_2 content and volume of outside air supplied to each passenger

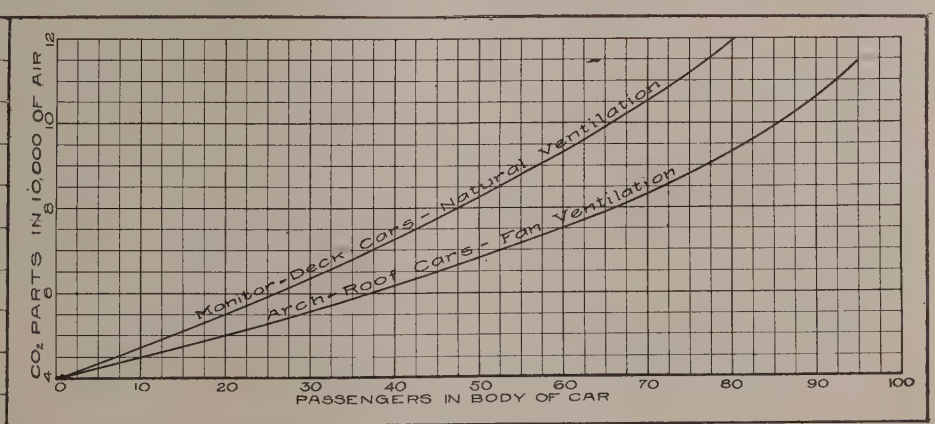


Fig. 5 (right)—Relation between CO_2 content and the number of passengers

V. Hill, ventilating inspector in charge for the Department of Health, advocated the use of some form of intake in conjunction with the exhaust ventilators for the purpose of supplying a fixed or uniform quantity of cool air to the interior of the car, in such a way that this cool air would reach the breathing zone in sufficient quantities to give the feeling of "freshness" resulting from direct contact, and also would be at all time sufficiently limited in quantity to prevent objectionable drafts.

A compensating type of intake to be placed in the end deck opening was developed by one of the manufacturers. This device was arranged with a movable vane, which was designed to compensate for the car speed or for head winds by reducing the intake opening as the car increased in speed and enlarging this opening as the car slowed down. Deflectors were arranged so as to direct the incoming air toward the headlining of the car and allow it to descend to the breathing zone, without causing an objectionable draft. This arrangement was a considerable improvement in car ventilating apparatus.

The success attending the installation of this combined system of intake and exhaust ventilators to the monitor deck cars encouraged the development of ventilators of this type for application to arch-roof construction. This development has been successful and the ventilating equipment being installed on new cars of the Chicago Surface Lines is of this type. A compensating intake, similar in principle to that used for monitor deck cars, has been developed for the arch-roof construction, and as the system is being applied compensating intakes are installed at the four corners of the car body, with exhaust ventilators spaced on either side of the roof between the intakes. While the car is operating in a given direction, the two rear intakes usually function as exhausts. From the results obtained, it seems that the most serious objection to the arch-roof construction has been overcome.

During the progress of the various tests conducted and studies made in connection with this interesting subject, a large volume of data have been accumulated, some of which may be of general interest. An attempt will therefore be made to summarize some of the more interesting results and present typical

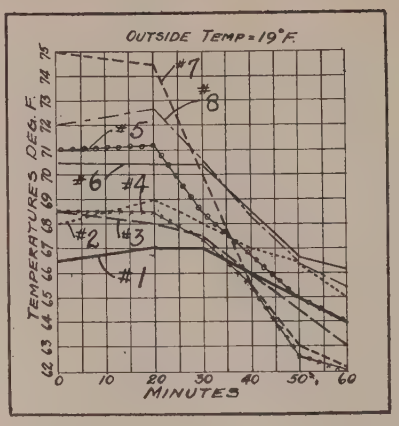


Fig. 6—Graph of temperature variations at locations indicated in Fig. 7; car outdoors, heat and ventilating fan on

sheets showing how the data of some of the tests were compiled, summarized and interpreted.

Circulation of Air in Monitor Deck and Arch-Roof Cars

Figs. 1, 2 and 3 represent the paths of air currents in monitor deck and arch-roof cars, the results having been obtained by introducing smoke and white fumes to the interior so that the paths of the various air currents could be observed. Fig. 1 represents these currents in a monitor deck car standing in the open air with the deck sash open and heaters turned on, when a cross wind was blowing directly against the car side. It will be noted that a considerable part of the air entering directly over the sash on the windward side blows across the headlining and out on the other side. Some of this cold air, however, descends along the walls of the car to the floor, where it is caused to rise by the action of the heaters. Another portion of the entering cold air is caught in the rising stream of warm air before it reaches the floor.

On the opposite side of the car, a smaller quantity of cold air also enters through the open deck sash, particularly at the ends of the sash. It is these direct streams of cold air

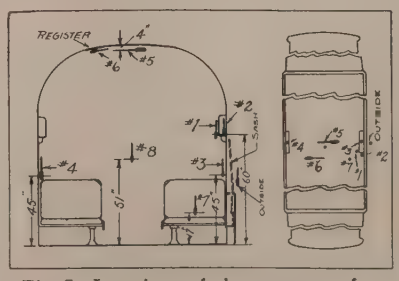


Fig. 7—Locations of thermometers for temperature readings of Fig. 6

that produce the objectionable drafts that make ventilation through open-deck sash unsatisfactory. The main body of warm air rises through the center of the car, and in Fig. 1 is deflected to the side away from the wind, while in Fig. 2, it is exhausted on both sides, generally over the top of the deck sash. The smaller streams of cold air which enter around the car doors, trapdoors and other crevices are also indicated. The various streams are intermingled and considerably diffused, particularly when the car is in motion. In general, however, the main streams of cold air descend close to the walls and the warm air from the heaters rises at the center of the car.

In the arch-roof car with exhaust fan ventilation, the convection currents resulting from the action of the car heaters are aided by the action of the fan, while the cold air enters through the various cracks and crevices in a more diffused condition than that which enters through the deck sash openings in the case of the monitor deck car.

A study of these diagrams will indicate the importance of mounting heaters as close to the floor as practicable for the various types of heater construction available. The ideal method would be to mount the heaters in a position on or in the floor, so that passengers can place their feet directly on the heater. The adoption of this scheme of mounting will probably follow rapidly on the development of a suitable heater for the purpose. Such a heater would require ample provision against mechanical damage by passengers and damage from water during the process of car cleaning and in wet weather.

Carbon Dioxide Content in Cars

Measurement of the carbon dioxide content in the air of an inclosed space has been a common means for determining the effective air supply for ventilation. Contrary to previous theories, the carbon dioxide in itself is no longer considered a harmful ingredient, but forms a ready index for determining the efficacy of the ventilating equipment in maintaining a proper interchange or dilution of the air within the investigated space. Fig. 4 is a curve which is very useful in interpreting carbon dioxide readings. It is taken from a preliminary report of the street car committee of the Chicago Commission on Ventilation, and shows the

number of cubic feet of outside air that is actually effective in producing dilution corresponding to various carbon dioxide determinations which in practice are obtained from samples taken from the air under investigation. This curve is based upon the formula:

$$CO_2 = \frac{6000}{\text{CFH per Pass.}} + 4$$

in which CO_2 represents the carbon dioxide content obtained in a sample of the air expressed in number of parts by volume in 10,000 parts of the sample. The term 4 represents the average carbon dioxide content in 10,000 parts of outside air under average conditions, and the factor 6,000 is based upon the production of 0.6 cu.ft. per hour of carbon dioxide by each occupant. CFH is an abbreviation for cubic feet per hour.

In practice the common method of making carbon dioxide determinations is to collect samples of the air in small sterilized bottles and to determine the carbon dioxide content of these samples by means of the Peterson-Palmquist apparatus. This aparatus, however, has several objections attached to its use.

A method of determining CO_2 developed by Professor McCormack of Armour Institute was used in a great many of the carbon dioxide determinations made by the railway companies, and was found to give consistent results and to be easily manipulated. The sample was obtained by pumping a given quantity of air from the car measured by means of a gas meter through a gas wash bottle containing a standardized barium hydroxide solution and then transporting the solution thus formed to the laboratory for analysis.

The curves shown in Fig. 5 represent an average of a great many observations made on both monitor deck cars with deck sash ventilation and arch-roof cars provided with exhaust fans. These curves represent the variation in the carbon dioxide content found with variable numbers of passengers in the car. In each observation, a complete record of all related data was made, and in a number of cases several determinations of carbon dioxide were made during a trip, in order to determine the maximum content which was reached at the point of heaviest congestion. The data recorded included the following items:

Date of test; car number; style of car (monitor deck or arch roof); route; direction of operation; location on trip; condition of ventilators (example, four deck sash open 4 in.); direction and velocity of wind; heater capacity in service; number of passengers in body and on platforms; time of taking sample; height above floor at which sample was taken; outside temperature; barometer reading; car temperature; quantity of air used for test, corrected for pressure and temperature; relative humidity.

Individual observations, of course, varied largely from the average curve shown. In each case these variations were due to factors which were indicated by the conditions observed at the time of making the test, and the curves presented represent the general average of the results.

Temperature at Various Locations Within Car

In Fig. 6 are shown the results obtained from an investigation to determine the air temperature at various locations within an arch-roof car. The readings of temperature were taken with chemical thermometers mounted in locations as shown in the cross-section and plan sketch of the illustration. In these sketches the location of the thermometers is indicated by numbers which correspond with the numbers applied to the graphic record shown at the right. This graphic record shows the results of readings taken for an hour on the various thermometers after the car had been run outdoors with the heat and ventilating fan on full.

The primary purpose of this investigation of temperatures at various locations was to determine how fair an approximation of the average temperature of the air within the car body was given by the service thermometer mounted on the body sign box. In the diagrams No. 1 represents the car thermometer mounted on the body sign box. No. 2 represents a test thermometer suspended at the end of the sign box. No. 3 represents a thermometer suspended about 4 in. from the body side sash and 45 in. above the floor. No. 4 represents a similar thermometer placed in a similar location on the opposite side of the car. No. 5 was placed directly in the center of the car about 4 in. below the headlining, and No. 6 directly under one of the openings leading from the car body into the exhaust ventilating duct. No. 7 was placed over the center of a cross-seat cushion 17½ in. above the floor. As indicated by the graphic record of temperatures observed, there is a considerable variation for different locations. It will at once be noticed that as the sign box thermometer, from which all observations of temperatures of cars in service are made, is in the stream of descending cool air adjacent to the sides of the car, it is really in a very poor position to give a fair indication of the actual average car temperature. The difficulty of mounting a service thermometer in any better location, however, has made it impractical to improve on the condition.

A number of tests of this kind, all made with the same object in view, on various types of cars, including monitor deck as well as arch-roof construction, indicated in general the same results. Lack of space prevents including a great deal of interesting data which have been collected. It is apparent, however, that if it were possible to mount a thermometer in the locations shown for No. 8, an average indicated body temperature between 3 deg. and 5 deg. F. higher would result.

Allowance Must Be Made for Location of Thermostat

Where thermostats are used for regulating car heaters, they are usually mounted either on the sign box or on a body side post, where the condition is even worse, as shown by the final temperatures obtained on thermometers 1, 3 and 4. This results in maintaining a temperature at location No. 8 anywhere from 3 to 5 deg. above that for which the thermostats are set and makes a considerable difference in the heat energy consumed. In calculations carried out to determine the effect of changing the thermostat setting 3 deg. under average winter conditions, it has been found that an increase in the thermostat setting from 52 deg. to 55 deg. or a difference of 3 deg. F. would result in a reduction in the saving made by the thermostat of approximately 15 per cent.

The experience of the surface lines in making a scientific determination of the proper heater capacity for various type cars, the study made of the radiation constant of cars under all the varying conditions, and the actual functioning and results of thermostatic control of heaters, are related in the remainder of this article, which will be published in next week's issue.

Developing Chicago's Street Cars

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The Good Features and Imperfect Points of the Successive Types of Cars Are Related—The Performance Experience, Coupled with Constant Engineering Study, Have Produced Many Changes—The Whys of These Are Told from the Experience of the Largest Street Railway System

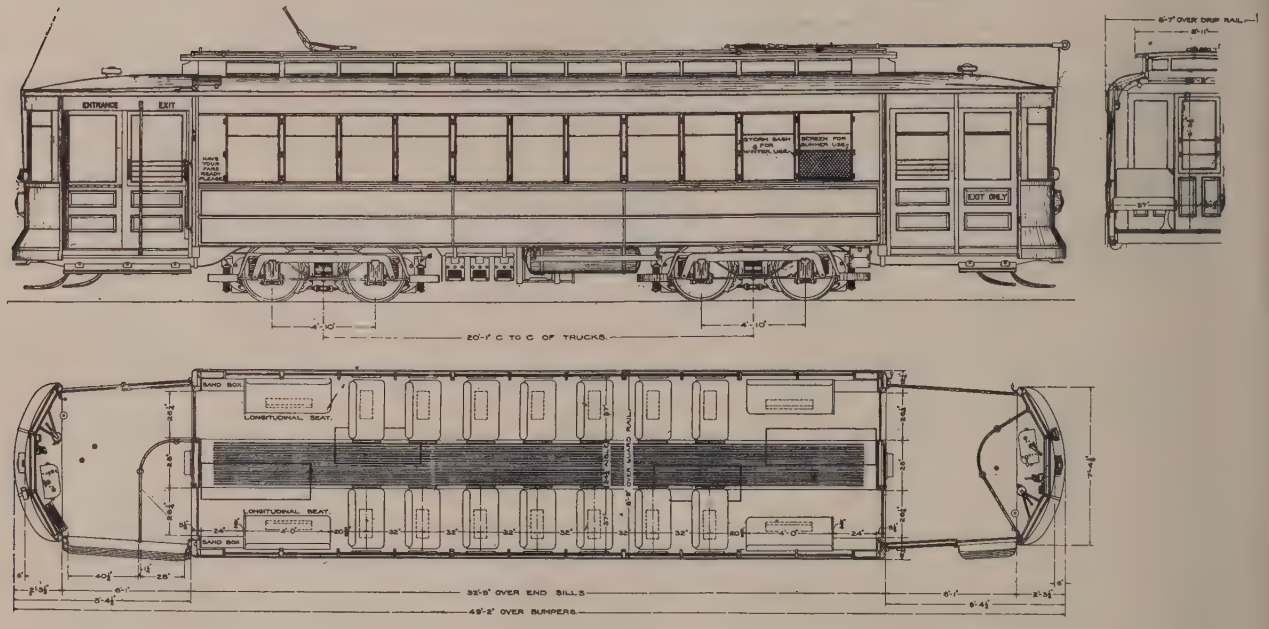

Fig. 1—General drawing of the first car design made by the Board of Supervising Engineers in 1908

THERE has been progressing in Chicago a continuous study of the elements of street car design since the 1907 franchises established the Board of Supervising Engineers, giving to that board complete charge of all work during the first three years constituting the rehabilitation period, and supervision of all work thereafter during the life of the grants. The ordinances named Bion J. Arnold as chairman of the board, and hence the work hereinafter related in connection with the progress of car design through the successive purchases since 1907 may be said to have been done under his general supervision. For the first three years, Mr. Arnold was also chief engineer of all new work. During this period 1,050 new cars were added to the system in three lots—600 composite cars in 1908, fifty all-steel cars in 1908-1909, 350 composite cars in 1909 and fifty composite cars in 1909-1910. This number was in excess of the franchise requirements, but was needed to care for the rapidly growing business of the companies.

Probably the most comprehensive idea of this car design work in Chicago can be gained from a study of the accompanying large table. Into this has been compacted what in effect reveals almost at a glance the complete story of the dimensioning and equipment of Chicago street cars, and the trend of development of each important detail. It covers the 2,445 cars added to the Chicago properties since and including 1907. By running down any of the columns the reader can quickly note what the trend has been as to the particular item. By such a study it will be noted, among other things, that the per seat weight of car body has been progressively decreased from 520 lb. to 219 lb., or per cubic foot of contents from 7.9 to 5.64 lb.; that the weight of the car completely equipped has shown the notable decrease per cubic foot of contents from 20.5 lb. to 11.7 lb.; that the weight of the trucks in per cent of total weight of cars has decreased from 35.5 to 19.6; that the weight of the motor equipment per horsepower has decreased from 60.5 lb. to 38.3 lb., etc. This brings out the fact that the general progress in car design is the result of the engineering and study put upon the subject by manufacturers and railway engineers alike, for both have contributed materially toward improving the efficiency and strength of the cars per unit weight.

The table discloses some interesting tendencies with respect to car body dimensioning. The car platform length, set at approximately 8 ft. with the first standardization of cars, thereafter was brought down to as short as 6 ft. 11 in., whereupon

the trend was again back toward 8 ft. In fact, the newest cars of the two-man type now on order will have platforms 8 ft. 1 in. long. The value of the large platform in prepayment service has been thoroughly established. Since the adoption of the arch roof in 1912, the over-all heights of car bodies have been somewhat reduced. This has tended to lighten the weight, though ample headroom and volume of car body has not been sacrificed. Step heights have been gradually reduced as more compact motors have become available. The improvements in the weight per cubic foot of car body became effective when the change in car side construction was introduced in 1913-1914. At this time a straight steel girder side was adopted as standard construction and this avoided much duplicate weight in the car side as compared with the previous construction employing a girder inside of the car wall and a curved construction on the exposed side. The improvement in the relative weight of the truck in comparison with the total car weight is of course the result not only of the use of better materials and more careful designing, but also the advance in motor construction which made possible the use of wheels of smaller diameter. A further study of the tables will reveal many more interesting comparisons tending to show the trend of the art of car designing as it has been worked out in Chicago.

At the time of the passage of the 1907 ordinances the companies had available for operation 905 double-truck cars, most of which were of the best design then known to the art, as they had been but recently purchased in 1905 and 1906. The remaining cars were of such construction and dimensions that practically all of them could be, and later were, rebuilt to conform as far as possible to good practice in car design as then established.

In the fall of 1907, one of the companies added 300 double-truck cars to its equipment, with full approval of the board. These cars had been designed and provided for prior to the passage of the 1907 ordinances. As these 300 pay-as-you-enter cars were of the latest and best type then known to the art, resulting from a most extensive study of cars in all cities in the country, they were carefully studied by the board in connection with its design of the additional passenger cars required immediately under the new franchises. The platform layout of these 300 cars designed prior to the creation of the board and the generous dimensions of door openings, aisle widths and seat spacings, all planned to promote the comfort of passengers and their rapid and easy movement, are among the features. These cars were designed for double-end operation, which is the general standard in Chicago service.

Important Details of 1908 Cars

As a result of observations made of the time of loading passengers on the 1907 cars, it was decided that the entrance passageway on the 600 board-designed cars bought in 1908 should be made about 40 in. instead of 34½ in., as it was believed that this would permit more rapid loading of passengers and would also increase the storage capacity of the platform, which was an important gain in a prepayment type of car. The details of this design are shown in Fig. 1.

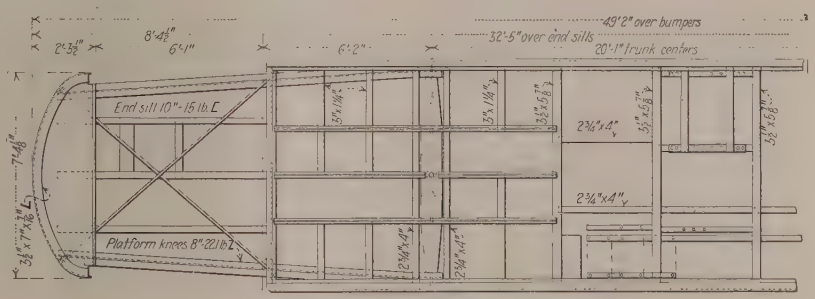

Fig. 2—Underframe construction on 1908 cars

Among other changes incorporated in the 1908 cars were the following: The cross-seats were spaced 32 in. centers instead of 33 in. This was done principally to increase the knee room between the longitudinal seats and the adjacent cross-seats. Cross-seat cushions were made 17 in. x 34 in. in order to provide a little more comfortable seat. This, together with the fact that the 1908 cars were made 8 ft. 7 in. wide over drip rails instead of 8 ft. 11 in. involved some sacrifice in the aisle width but still left it 24¾ in., sufficient to accommodate the movement of passengers and provide for standees. While the car width was reduced 3 in. the aisle width even with a longer seat cushion was reduced only 2 in. This result was made possible by the adoption of a car with raise sash instead of drop sash. It was realized that raise sash would not provide a semi-open car as is possible with the sash arrangement on the 1907 cars. Observations indicated, however, that this feature was frequently not taken advantage of so that a design would give the same practical results. The raise type of sash have other advantages, such as maximum width of aisle for a given over-all width, absence of pockets and comparative ease of operation, which caused this type of car to be selected. It may be noted that all cars since built are fitted with raise sash. Storm sash are fitted to these cars for winter service, as is also done with the 1907 cars. It has been observed that these storm sash make it possible to keep the cars at least 5 deg. warmer.

The sash frames throughout these cars were made of pressed steel treated to eliminate rust. Steel sash with narrow rails were used because it was felt the following advantages would be secured: Long life; no sticking in sash runs; increased light in the car and wider vision for passengers.

This type of sash was not successful from the standpoint of life in service, most of them lasting from twelve to fourteen years, but many considerably less. The other advantages were realized.

The floors in these cars were made of maple instead of hard pine so as to reduce the wear, especially between seats and around doorways. The maple floor has proved its merit in service and it has been standard construction since.

In designing the underframe to support a car body in which raise sash were used, it was not thought practical to utilize an overtruss because it would interfere with the placing of seats between the body side posts. This decision was also influenced by the fact that due to the great overhang of the platforms and their large carrying capacity, the stress in a truss bar of any practical section would be excessive. A plate girder design (Fig. 2) was

therefore decided upon and in planning the section of this girder it was of course recognized that the most economical design would be one with the maximum possible depth. In a street railway car where wood superstructure is used, the maximum depth of girder is the distance from the bottom of the side sill to the bottom of the side window openings. In this case it was about 18 in. At the time of the design of these cars it was not thought practical to place the web of the girder so that it would form the outside wall of the car, because of direct exposure to mechanical injury and the desire to retain the concave-convex car side. The girder was therefore so placed that its web formed the inner wall of the car and the body side posts were placed outside. The body posts were covered with wooden sheathing and this sheathing protected with sheet-steel panels.

In determining the cross-section of the girder side sill a loading table was made up which showed the weight and location of all apparatus, fittings and equipment of the car and the weight and distribution of the passengers based on maximum loading. From these data and the dimensions of the car framework was calculated the bending moment at the critical section, viz.: the body bolster location, where, of course, the moment is maximum. The maximum bending moment in the platform knees was also obtained from these data. The section of the side sills of the underframe was built up to give the required section modulus which was based on a unit stress of approximately 12,000 lb. per square inch.

The platform knees are made of 8-in. Z bars of such weight and so reinforced with angles at the body end sill that they have a good margin of safety. After fourteen years service the side sills and platform knees of these cars are still in perfect alignment.

The end sills are made of 10-in. standard steel channels, and as the platform knees are of steel there is metal to metal bearing between these members. This construction was adopted to eliminate any possibility of looseness developing at the juncture of end sill and knee. The steel channel and sill is also lighter than the composite type. This was the first lot of cars in which the steel channel end sills was used and it was considered to possess such advantages as to make it standard construction on all cars since built. Experience has fully confirmed the wisdom of this choice.

The body bolsters were made in one piece of cast steel, and it is believed that this is one of the first instances in which this kind of bolster was used in street railway cars. Cast steel was chosen because it was believed weight could be saved and a stronger and more reliable construction secured. Experience has confirmed this belief, and as far as is known, out of several thousand in service, none have failed, although several have been badly bent in wrecks. In such cases they have been straightened and returned to use.

In the framing around trapdoor openings in the floor T-iron was used as in the 1907 cars. This construction has proved good in service and has been followed in all subsequent cars.

The platforms of these cars are of such length that diagonal bracing was considered necessary and it was provided with rods. This has proved effective in service. The underframe as a whole is very substantially constructed, although somewhat less in weight than that for the 1907 cars. Part of this reduction in

Data Covering Dimensioning, Construction, Equipment and Weights

Item Number	Number of Cars	Year Added to the Properties	General Type (All P. A. Y. E.) (All closed except 1907 group)	Seating Capacity: Body	Seating Capacity: Platform	Seating Capacity: Total	Standing Room (Sq. Ft.)	Principal Dimensions of Car: Length of Body	Length of Platform	Length of Overall	Width Overall	Height of Body-Bottom of Sill Over Roof	Trucks: Type	Trucks: Wheel Base	Air Brake Equipment: Type	Air Brake Equipment: Size of Compressor, Cu. Ft.	Motor Equipment: Number of Motors	Motor Equipment: Type
1	300	1907	Dble truck, dble end, semi convert	40	..	40	166	32 ft.-5 in.	7 ft.-11 in.	48 ft.-3 in.	9 ft.-0 in.	8 ft.-11¼ in.	Brill 27-FE-1	4 ft.-6 in.	National A-4	16	4	G.E.-80 straight seri
2	600	1908	Dble truck, dble end	40	..	40	165	32 ft.-5 in.	8 ft.-4½ in.	49 ft.-2 in.	8 ft.-9 in.	8 ft.-10⅜ in.	Pullman 150	4 ft.-10 in.	National A-4	16	4	GE-216-A interpole
3	50	1908–09	Dble truck, dble end, all st	40	..	40	162	32 ft.-5 in.	8 ft.-4½ in.	49 ft.-2 in.	8 ft.-9 in.	8 ft.-8½ in.	Pullman 150	4 ft.-10 in.	National A-4	16	4	G.E.-216-A-interpole
4	350	1909	Dble truck, dble end	40	..	40	143	31 ft.-6 in.	7 ft.-3 in.	46 ft.-0 in.	8 ft.-6 in.	9 ft.-0 1/16 in.	Pullman 150	4 ft.-10 in.	National A-4	16	4	West. 319-B interpo
5	50	1909–10	Dble truck, dble end	40	..	40	144	32 ft.-0 in.	7 ft.-0 in.	46 ft.-0 in.	8 ft.-6 in.	8 ft.-11⅝ in.	Brill 27-FE-2	4 ft.-6 in.	Allis-Chalmers AA-6	16	4	G.E.-80 straight seri
6	215	1912	Dble truck, dble end	40	..	40	136	31 ft.-2 in.	6 ft.-5 in. 6 ft.-11 in.	44 ft.-0 in. 45 ft.-0 in.	8 ft.-6 in.	8 ft.-10¼ in.	Brill 27-GE-1	4 ft.-10 in.	National A-4	16	4	G.E.-226 interpol ventilated
7	125	1912	Dble truck, sgle end, near side	53	..	53	124	38 ft.-1 in.	7 ft.-7 in.	45 ft.-8 in.	8 ft.-6 in.	8 ft.-10 in.	Brill 39-E	4 ft.-10 in.	G. E. C.P.-27	16	2	West. 306 interpole
8	100	1913	Dble truck, dble end	50	5	55	121	32 ft.-8 in.	7 ft.-8 in.	48 ft.-0 in.	8 ft.-6 in.	8 ft.-11⅛ in.	Brill 39-E	4 ft.-10 in.	G. E. C.P.-27	16	2	G.E.-242 interpol ventilated field co trol
9	200	1913–14	Dble truck, dble end	48	5	53	127	32 ft.-5 in.	8 ft.-0 in.	48 ft.-5 in.	8 ft.-6 in.	8 ft.-7⅛ in.	Brill 39-E.	4 ft.-10 in.	National A-6	16	2	West.-534 interpol ventilated field co trol
10	228	1914–15	Dble truck, dble end	50	5	55	127	32 ft.-8 in.	7 ft.-8 in.	48 ft.-0 in.	8 ft.-6 in.	8 ft.-8¼ in.	Brill 39-E.	4 ft.-10 in.	G. E. C.P.-27	16	2	G.E.-242 interpol ventilated field co trol
11	1	1921	Sgle truck, dble end, l-man safety (Ry. design)	36	..	36	72	.....	.....	29 ft.-4¾ in.	8 ft.-0 in.	8 ft.-5 1/16 in.	Brill 79-E	8 ft.-0 in.	C.E. C.P.-25	10	2	G.E.-264 interpol ventilated
12	10	1920	Sgle truck, dble end, l-man safety ("standard")	32	..	32	60	.....	.....	28 ft.-0⅛ in.	7 ft.-8 in.	7 ft.-5 11/16 in.	Brill 79-E	8 ft.-0 in.	G.E. C.P.-25	10	2	G.E.-264 interpol ventilated
13	1	1921	Dble truck, dble end, l-man safety	36	10	46	95	23 ft.-8 in.	6 ft.-9 in.	37 ft.-2 in.	8 ft.-6 in.	8 ft.-8¼ in.	Brill 77-E-1	4 ft.-10 in.	Westinghouse Bungalow	16	4	West.-508 interpo ventilated
14	101	1921	Dble truck, dble end, trler	60	2	62	117	.....	.....	47 ft.-6 in.	8 ft.-6 in.	8 ft.-8¼ in.	Brill 67-F	4 ft.-4 in.	.....	.....	..	Trailers
15	45	1922	Dble truck, dble end, l-man safety	40	10	50	101	26 ft.-1½ in.	6 ft.-9 in.	39 ft.-7½ in.	8 ft.-6 in.	8 ft.-8¼ in.	Brill 39-E	4 ft.-10 in.	G.E. C.P.-27	16	2	G.E.-275 interpol ventilated
16	69	1922	Dble truck, dble end, 2-man	44	6	50	146	32 ft.-9 in.	8 ft.-1 in.	48 ft.-11 in.	8 ft.-6 in.	8 ft.-8¼ in.	Brill 51-E-2	4 ft.-10 in.	G.E. C.P.-127	20	4	G.E.-275 interpol ventilated*
	2,445																	

* Capable of handling trailers in all-day service. † Weight of truck without motor in per cent of maximum center plate load. *e* Estimated. *a* Approximate. *x* At 600 volts.

weight is due to the fact that this car is 3 in. less in width, though better design was also a factor.

ALL STEEL CARS PURCHASED IN 1908-1909

The chief engineer of the work under the 1907 ordinances felt that in view of the possibilities of all steel cars it would be wise to secure some experience with such equipment. Under his direction, plans and specifications were prepared for the construction of fifty such cars, listed in the table as the 1908-1909 group. It was expected that the following advantages would be realized with these steel cars: Long life, fireproof, and low maintenance cost. The general dimensions of these cars and the arrangement of seats and platforms is the same as for the 1908 cars just discussed.

It was the intention to eliminate wood from their construction as far as practical and the only items in which this material is used are:

Steps: The step boards or treads were made of wood principally because of ease of repair.

Floor mat strips: These were made of hard maple to provide an anti-slip surface and a readily renewable construction.

Body and platform doors: Doors were made of wood to save weight and cost.

Trolley boards: These were made of wood in order to provide a proper insulation for the trolley bases.

In other places where wood is customarily used, steel was substituted.

The framing is characterized by the use of thin pressed sections throughout, with the exception of a few connections where steel castings are used. In the underframe, the platform knees, end sills, bolsters and crossings are all pressed members. The sections of these members except the end sills are varied in depth which results in light-weight construction. The side member is of the girder type with $\frac{3}{32}$-in. web plate extending from bottom sill to the window arm rest and reinforced at this point with a flat bar. This was the first lot of cars in which this type of frame was used. The girder is so placed that the web forms the inside wall of the car, the steel posts being riveted to the outside of the web. On the outside faces of the posts is riveted the outside steel panels, which are so placed with guard rail between top and bottom panels as to give the appearance of a concave-convex side car. This construction was possible because of the use of steel side posts which permitted a thin side wall. It was necessary however, to decrease the aisle width $\frac{3}{4}$ in.

These steel cars weigh about 500 lb. less than the 1908 composite type cars, both being built to substantially the same dimensions. They have been quite satisfactory in service, but experience has shown that the composition cement floor is not practical. It wears rapidly, is very heavy, and makes an uncomfortable floor to stand on in wet or cold weather. These floors have been replaced with wooden ones. The thin interlocking steel floor base has also proved impractical in that it rapidly rusts out, especially at points where wheel wash is thrown against it. This is also true of all thin sections of the underframe which are exposed to such action.

The expectation that it would be comparatively easy to replace bent or damaged sections has not been altogether realized, owing in many instances to the method of fastening these parts to the framing. The steel sections such as vestibule posts and body corner posts are of such shape that they are very resistant to mechanical injury and therefore they

of Chicago Street Cars Showing Trend of Development

Motor Equipment					Heaters		Lights At 25-watt Mazdas)					Construction		Underframe				Height of Car Steps (In.)			Weight of Car Completely Equipped Less Passenger Load (Lb.)					Weight of Bare Car Body (lb.) (approximate)						
Weight (lb.) Motor Less Gearing	Per Lb. at 500 V.	Total rating motors Per car at 500 V.	H.P. per ton of Light Car	Controllers	No. Platform	No. Body	Watts per car at 550 V.	In Signs	On Platforms	Headlights	In Body	Total	Roof	Side	Type	Bolsters	Dia. Wheels (In.)	Height at floor (In.)	Ramp on car floor (In.)	Rail to Step	Step to Platform	Platform to Car Floor	Total Car	Per Seat	Per Foot Length	Per Sq.Ft. of Floor Area	Per Cu.Ft. of Contents	Total Body	Per Seat	Per Ft. of Length	Per Sq.Ft. of Floor Area	Per Cu.Ft. of Contents	Trucks,† Weight Factor, Per Cent	Item Number
2,420	60.5	160	5.92	K-28	2	20	12,584	2	2	2	21	27	Monitor	Concave-Convex	Over truss semi-steel	Steel built up bolted	34	40¾	none	17	13	10	54,040	1,351	1,120	161	20.5	20,800	520	431	62	7.90	35.5	1
2,430	60.8	160	6.04	K-35	2	20	12,584	2	2	2	21	27	Deck	Curved,	Plate girder semi-steel	Cast Steel	34	40	none	17	13	10	53,060	1,325	1,078	155	20.9	20,000	500	407	58	7.90	32.3	2
2,430	60.8	160	6.09	K-35	2	20	12,584	2	2	2	21	27			Plate girder all steel	Pressed Steel	34	40	none	17	13	10	52,500	1,313	1,068	150	20.8	19,550	488	397	56	7.78	32.5	3
2,587	64.6	160	6.34	K-35	2	20	12,584	2	2	2	21	27			Over truss all steel	Cast Steel	34	40	none	15	14	11	50,500	1,263	1,098	160	21.9	17,530	438	381	55	7.62	33.6	4
2,420	60.5	160	6.03	K-28	2	20	12,584	2	2	2	21	27			Over truss all steel	Cast Steel	34	41½	none	16½	14	11	53,040	1,326	1,152	171	23.2	19,000	475	413	61	8.32	35.0	5
2,037	58.3	140	6.11	K-35	2	20	12,584	2	2	2	16	21			Plate girder	Built up riveted	34	40⅜	none	16⅛	13⅝	11	45,500	1,138	1,011	148	20.4	15,600	390	347	51	7.00	33.8	6
2,553	51.1	100	5.46	K-36	2	20	12,584	2	2	1	20	25			Over truss all steel	Cast Steel	34	39	1½	14	13	10½	36,600	691	802	118	15.1	15,000	283	329	48	6.25	28.0	7
2,982	54.2	110	5.10	K-51	2	22	12,584	5	4	2	18	29			Over truss all steel	Cast Steel	34	38½	3	13½	12	10	43,120	785	898	131	17.8	19,150	348	334	58	7.85	25.0	8
2,533	50.6	100	5.50	K-51	2	22	11,800	2	2	2	16	22			Deep Plate Girder	Cast Steel	32	37	2½	13	11½	10	35,800	676	739	104	13.8	13,720	259	283	40	5.30	26.3	9
2,982	54.2	110	5.47	K-51	2	22	12,584	5	4	2	18	29				Cast Steel	34	39	3	13½	12½	10¼	40,180	730	838	118	16.1	17,000	309	354	50	6.80	25.0	10
900	45.0	50x	.....	K-63	..	12	7,200	4	4	2	8	18	Arch Roof	Straight Steel Sides			26	27 3/16	.....	14	13 3/16	....	16,375	457	560	84	11.7	7,900	219	269	41	5.64	19.6	11
900	45.0	50x	.....	K-63	..	12	7,200	4	4	2	8	18					26	28 1/16	none	16⅞	12 7/16	....	16,460	514	588	87	12.9	8,100	253	289	43	6.37	20.6	12
900x	45.0	100x	5.74	K-35	4	18	10,648	3	4	2	14	23				Cast Steel	26	31	none	13	12	6	28,050	623	755	107	14.1	10,900	238	288	41	5.40	31.5	13
.....	.....	.....	.....	.....	2	22	11,616	..	..	..	20	20				Cast Steel	22	31½	5⅜	15⅜	....	10⅜	26,000	419	549	78	10.4	14,080	227	297	42	5.64	22.4	14
2,300x	38.3	120	6.6	K-68	2	20	10,648	3	4	2	14	23				Cast Steel	28	33	none	4½	12½	6	30,300	606	765	113	15 2	11,100	222	281	42	5 56	30.0	15
2,300x	38.3	240	8 7	K-35 HH	2	22	12,584	5	4	2	18	29				Cast Steel	28	37½	none	15¼	13 1/16	9 5/16	46,000e	920	941	135	17.6	15,500	310	327	46	5.90	30.7	16

[1] Bottom sash drop into pockets; top sash raise into roof. [2] Bottom sash raise. [3] Bottom sash drop into pockets.

suffer little from those blows which would do considerable damage to wooden posts. The same is more or less true of the body side panels. As far as these items are concerned the upkeep cost has been reasonable. A considerable stock of spare pressed sections were purchased with the cars and replacements have thus been available.

No additional all-steel cars have been purchased by the Chicago companies, chiefly because of the high first cost of such cars, which in this instance amounted to about 20 per cent more than the 1908 composite cars. Shop equipment is also laid out on a basis of repair for composite cars. The tendency, however, in car design is toward a greater use of steel as will be noted from the discussion on the later lots of equipment added to the Chicago properties.

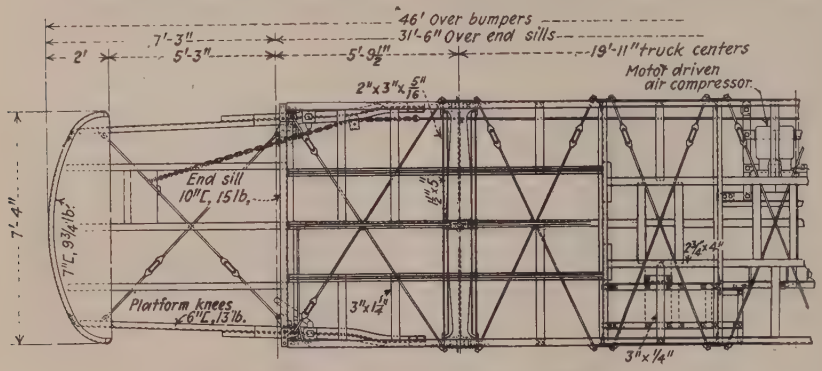

Fig. 3—Underframe construction on 1909 cars

350 Smaller Cars Purchased in 1909

The companies with the addition of the 950 large double-truck PAYE cars just described, and the remodeling of 100 such cars acquired just prior to Feb. 1, 1907, now owned 1,050 large cars capable of satisfactorily handling the heaviest service.

It was therefore felt that sufficient equipment of this class was available for some time to come and that the immediate requirements could be met with cars of somewhat smaller capacity. The next lot of equipment, 350 cars, added in 1909, were therefore built somewhat smaller.

The concave-convex car sides with top and bottom panels divided by a guard rail was followed again in these cars as in former designs because of the belief that the appearance of such design is superior to any other. The wooden panels in this case were, however, not covered with steel plates as formerly. These plates were omitted to save weight, it being estimated that this omission would result in a saving of approximately 450 lb. per car. It was recognized that there would probably be more smashed side panels than if the steel cover plates were used, but on the other hand, the steel plates gave considerable trouble due to rusting out. These steel panel plates were later removed from the 1908 cars for the reasons just stated.

Sliding Type of Bulkhead Doors Adopted

The body bulkhead doors were all made of the sliding type, instead of one sliding and one swinging door as in the 1908 cars. This change was made because of the inconvenience of the swing door, and the space taken by it in swinging into the car body. The swing door is not easy to keep in adjustment to prevent it blowing or standing open and its cost of upkeep is greater than the sliding door. A 10-in. saving in car body length was possible through this change.

By spacing the cross-seats somewhat closer, an additional saving in car body length was secured, so that in these cars, this dimension is 31 ft. 6 in. as compared to 32 ft. 5 in. in the cars preceding this equipment. The over-all width of the car is 8 ft. 6 in. instead of 8 ft. 9 in. and 8 ft. 11 in. in the earlier models. This change in over-all car width was made to provide somewhat more space between passing cars and to reduce car dimensions and therefore weights to the lowest practicable figures consistent with good design and the requirements of the service.

The monitor type of roof was used on this as on all previous cars, principally because it was then thought that sufficient ventilation was difficult to obtain in any other type of roof construction. By virtue of the thin car side walls made possible with a raise sash design, cross-seats with 17-in. x 34-in. cushions and an aisle of 24-in. width between seat end plates were secured with an over-all width of 8 ft. 6 in. The underframe for these cars was designed with a view of obtaining the lightest structure possible consistent with the loads to be carried and is shown in Fig. 3. Experience with former cars having shown the desirability of lateral stiffness in the car underframe, this design was liberally provided with diagonal rod bracing which is effective and light in weight.

It was also decided to use a special type of steel body post with corrugated sides which had been successfully used in other classes of cars. The corrugated sides of this post form the sash and curtain runways. These steel posts also make possible a thin side wall because their depth can be made less for the same strength than wooden posts. These steel posts were specially treated to minimize rusting.

While these posts have given satisfactory service they have not been used in succeeding lots of equipment chiefly because of their special design, which means added cost and requires special sash fittings. The anti-rust treatment has not been altogether successful.

Steel sash were used in these as in the 650 cars immediately preceding. As in the earlier cars, these sash have suffered from corrosion due to rust and have been largely replaced with brass sash, and more recently, because of excessive cost of metals, replaced with wood sash.

Trend Toward Reduced Dimensions Continues

The last lot of cars, fifty in number, added by one of the companies in the three-year period of immediate rehabilitation and listed in the table as the 1909-1910 group, were also of somewhat less dimensions than the first 950 large cars. These are very similar in general dimensions and equipment to the lot of 350 cars just described and listed as the 1909 group. They have proved very satisfactory in service.

This brings the discussion of Chicago's car design experience and development down through the cars purchased during the three-year rehabilitation period. The development since that time, carried up through the 1922 additions to rolling stock, will be published in next week's issue of the *Electric Railway Journal.*

Experience with Chicago Track

By CHARLES S. HOLCOMB
Assistant Engineer Track and Roadway
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The Types of Construction Used Since 1907 Have Given Very Good Results—The Few Changes in Details Found Desirable to Meet Heavy Duty Are Related—Weighted Life of Track and Special Work and Relation Between Traffic and Rail Wear Given

THE greater part of the street railway traffic in Chicago has been carried on four types of track used in rehabilitating the surface lines since 1907. For convenience these types will be briefly described in the following order: Type 2-A, Type 2, Type 1 and Type 3.

Type 2-A track was constructed with 9-in. 129-lb. grooved girder rail laid on 6-in. x 8-in. x 7-ft. wood ties surfaced four sides. These ties were imbedded in concrete which extended from 6 in. below to about 3 in. above the tie. The tie spacing was 3 ft. on centers and the fastenings consisted of four screw spikes per tie used in connection with 7½-in. x 9½-in. shoulder tie plates.

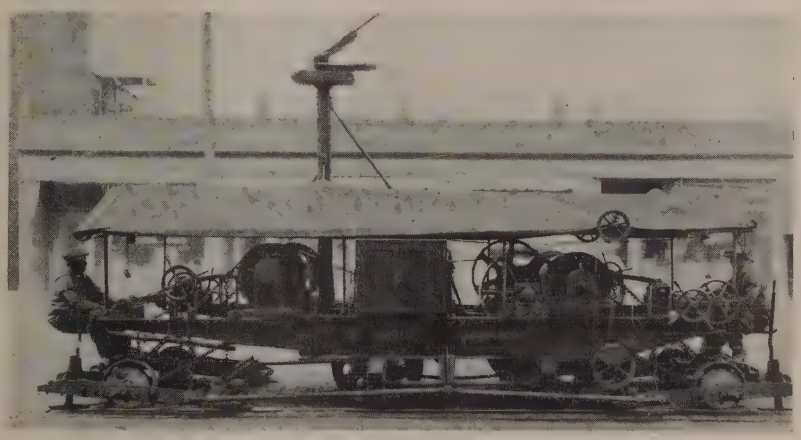
Type 2 track was of the same general design as type 2-A, the variations from type 2-A being due to the fact that type 2 was built almost entirely on streets where the original track had been built for cable car operation and in consequence the new track had to meet certain special conditions. This old cable track had a continuous concrete slot down the center of each track and the rails were supported on heavy iron yokes, well imbedded in concrete and spaced about 4 ft. on centers.

In most cases this old concrete was in excellent condition and could have been entirely removed only at great expense. This expense would not have been justified as the old concrete made an unusually solid sub-foundation for the new track. As a consequence where new track was laid above cable track only such portions of the old cable concrete were cut away as was necessary in order to have not less than 6 in. of new concrete below the ties and not less than 12 in. under the rails.

It was the general practice on this type of track to place the ties for the new track between the cable yokes of the old track. Type 2 track might therefore be described as type 2-A track with the tie spacing about 4 ft. instead of 3 ft. and with pyramids of material from the old track projecting up between the ties. Nearly all of the type 2 track built was built during the years 1907 and 1908.

Type 1 track was of the same general design as type 2 except that steel ties, attached to the rail by clips and wedges, were used instead of wood ties. Nearly all of the type 1 track was built during the year 1907.

Type 3 track was constructed with 9-in. 129-lb. grooved girder rail laid on 6-in. x 8-in. x 7-ft. wood ties surfaced four sides. These ties rested on 8 in. of crushed stone or crushed slag ballast and were covered with concrete from the bottom of the tie to about 3 in. above the tie. The tie spacing was at 2-ft. centers and the fastenings consisted of four screw spikes per tie used in connection with 7½-in. x 9½-in. shoulder tie plates.



Double-end grinding machine has greatly facilitated removal of corrugations and lowered the cost

As stated before, types 1 and 2 were used almost exclusively where new tracks were laid over old cable track construction. Both types 2-A and 3 have been laid on almost every variety of subsoil in the city and under all kinds of traffic density. In a general way, however, type 2-A track has been used where the subsoil conditions were poor and where traffic conditions were such that the track concrete could be allowed fourteen days to set before the track was opened to service, while type 3 track has been used where the subsoil conditions were good and traffic conditions were such that the track concrete could not be allowed fourteen

TABLE I—MILEAGE OF TRACK BUILT IN CHICAGO BY TYPES UP TO JAN. 31, 1922

Year	Type 1	Type 2	Type 2-A	Type 3
1907	6.884	11.352	3.484	24.723
1908	.....	57.058	10.509	28.955
1909	.....	.....	86.849	31.887
1910	.....	.....	37.952	21.490
1911	.....	.....	64.116	38.997
1912	.....	.....	30.610	8.494
1913	.....	.....	42.356	19.933
1914	.....	.....	31.226	20.136
1915	.....	.....	37.691	3.208
1916	.....	.....	34.303	2.903
1917	.....	.....	17.256	1.563
1918	.....	.....	3.650	3.549
1919	.....	.....	1.491	0.854
1920	.....	.....	0.294	0.234
1921	.....	.....	.....	0.341
Totals	6.884	68.410	402.547	207.266

days to set. An accompanying table shows the amount of each class of track built up to Jan. 31, 1922.

Type 1 track was discontinued after 1907 and type 2 after 1908, but this was due largely to the fact that the greater part of the old cable track had been reconstructed by the end of 1908 and that type 2-A was better suited to other conditions where a solid concrete foundation was desired. Types 1 and 2 were built chiefly on streets that contained old cable track and as these were the main lines of travel to and from the business district these two types have been under very heavy traffic ever since they were laid without giving any special trouble attributable to the type of construction. As stated before, the tie spacing on this track was governed largely by the

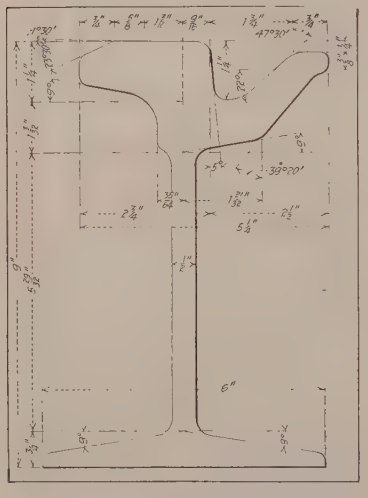


Fig. 1—Rail section used as standard in Chicago

spacing of the old cable yokes, which was about 4 ft. on centers. While no special trouble has resulted from this wide tie spacing it throws a considerable strain on the rail fastenings and ties, especially under the heavy and continuous traffic that these types have carried, and this is another reason for the change to type 2-A track where the tie spacing is at 3 ft. centers.

Types 2-A and 3 have been used with equal success in most places, the type of track being governed largely by whether or not it was possible to hold traffic off the track for the two weeks required for type 2-A. In the downtown business or Loop district, where most of the streets could not be closed for two weeks, the tracks are very largely of type 3 construction, which has been satisfactory under these trying conditions.

TABLE II—AVERAGE WEIGHTED LIFE OF TYPES 1, 2, 2-A AND 3 TRACK

Type of Track	*Average Weighted Life Years	Remarks
1	14.5	
2	13.7	
2-A	9.5	
2 and 2-A	10.0	All solid concrete track having wood ties.
1, 2, and 2-A	10.1	All solid concrete track.
3	10.9	All ballasted track.
1, 2, 2-A and 3	10.4	All heavy construction track.

*The average weighted life was obtained by multiplying the number of feet of track of each kind built in each year by its age as of Jan. 31, 1922, and dividing this total by the amount of track of each type as of Jan. 31, 1922.

Considering the whole track structure as a unit, none of the four types of track under consideration can be said to have worn out or be likely to wear out for some time to come. Certain portions of the track structure have had to be replaced, but these replacements have in most cases, been due, not to the type of track but to the failure of the parts themselves. These items will be considered in detail later. The life of Chicago track on a weighted basis is given in Table II.

The variation in car traffic over the standard types of track is very great, running from a maximum of eighty-two cars per hour for a twenty-hour day down to about eight cars per hour. The vehicular traffic also varies as greatly, being all the way from practically nothing to an almost continuous line of heavily-laden trucks and wagons. This variation in traffic conditions will be taken up again in connection with a discussion of rail wear.

Subsoil Conditions in Chicago

Three general types of subsoil are encountered in Chicago—sand, clay and filled land. Along the entire lake front and for some distance back into the city the soil is almost entirely lake sand. When properly confined this gives a firm foundation and excellent drainage. In the more westerly sections back from the lake shore the soil is almost entirely clay. This clay is thoroughly rolled before placing the track and has given good satisfaction as a foundation although it has been necessary to install drain tile at some locations. Both solid concrete and ballasted types of foundation have been used with success on this subgrade, but the solid concrete type has been used to the greater extent. In the southeast portion of the city, known as South Chicago, the streets are above the level of the natural ground in many places and tracks laid on these streets have a subgrade composed of the miscellaneous material used in filling. However, the traffic in this section of the city is comparatively light, hence almost no track of the heavier type of construction has been laid on such subgrade. There are a few locations where tracks cross ridges of limestone rock but the amount of such track is so small that no change in the type of construction has been made on account of such subgrade.

As noted before, the types of foundation used are two in number, solid concrete and crushed stone, or crushed slag ballast. Both of these types of foundation have given excellent results except in a few cases. In almost all of these cases the foundation failures were due to conditions over which the street railway

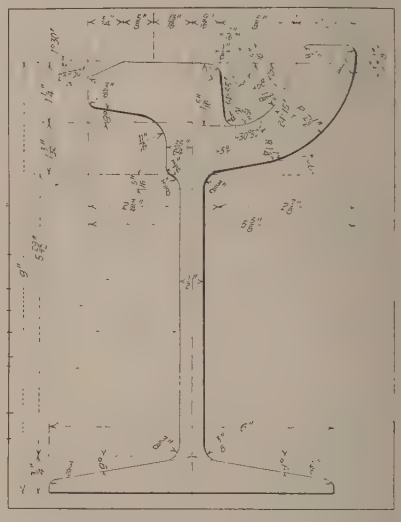


Fig. 2—Guard rail used in Chicago which fishes with standard section

companies had no control. In some cases the new tracks were built over sewer ditches which had been filled for some time and were supposed to have thoroughly settled but which later settled still further, causing a settlement in the track. In other cases, especially in the Loop district, deep building foundations excavated to the curb line caused the entire street to settle, including the railway tracks. In only one instance has it been necessary to change the type of foundation on any considerable length of track because of foundation failure. This was on 1½ miles of track laid as type 3 in 1907, which settled so badly, due to poor subgrade, that it was necessary to place a 2-A foundation under it in 1914.

Several kinds of ties have been used at various times, but by far the

greater number are 90 per cent heart untreated, long leaf yellow pine, 6 in. x 8 in. x 7 ft., dressed on four sides. In the earlier years a small per cent of treated ties were used, the greater number being treated with creosote and zinc chloride. No special difficulty has been encountered with any of these ties except those treated with zinc creosote. Where such ties were laid, the rail soon showed signs of loose fastenings and upon investigation it was found that the screw spikes used were so badly eaten away that they had lost practically all of their holding power. The use of zinc chloride treated ties was therefore discontinued.

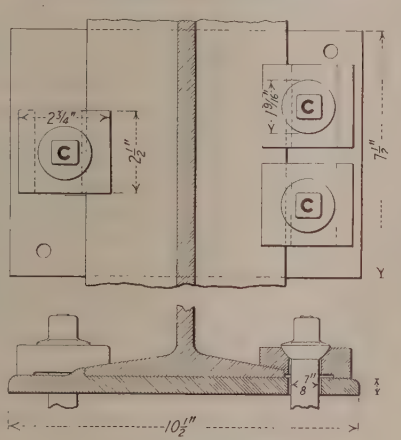
The long leaf yellow pine ties, when incased or partially incased in concrete as in the types under consideration, give a very satisfactory life. In fact, there is hardly any track of these types where there has been any appreciable tie renewal.

A large number of ties have been uncovered at the end in connection with the renewal of rail fastenings, and almost without exception they have been in such condition that new fastenings could be placed on the old ties. Most of these ties have had ten or more years in the track and in many cases appear to be in much the same condition as when placed. In most cases where holes are bored for new screw spikes in these old ties, the borings brought up are of a gray color for the first half inch or so, but for the remainder of the depth are of the same bright yellow color as those coming from a new tie. It is interesting to note that in a large number of cases these borings were damp, showing that the ends of the ties at least have absorbed some water even though completely incased in concrete. In practically no case has the tie appeared to have become loosened from the surrounding concrete.

Oak ties, both with and without tie plates, were used in some of the earlier track. These ties have proved satisfactory but appear to have given no better results than the standard yellow pine tie.

Steel ties have likewise proved to be satisfactory, but their use has been confined largely to type 1 track and to locations where the shallower tie was needed to get adequate headroom. Several stretches of track have been laid under normal conditions with steel ties, but to date this track does not seem to have given any better results than similar track laid with wood ties.

Tie plates have been used on nearly all ties laid in types 1, 2, 2-A and 3, except for a few miles of track laid on oak ties in the earlier years of rehabilitation. The tie plates used until about 1913 were shoulder tie plates 7½ in. x 9½ in. x ½ in., but after that date a new shoulder tie plate 7½ in. x 10½ in. x ½ in. was introduced in connection with a new clip fastening. The latter is now the standard plate. It is described more fully in the next paragraph. Tie plates uncovered in connection with the renewal of rail fastenings generally show wear on the upper face of the tie plate, but as a general thing the plate has not cut down into the tie. The use of tie plates on heavy traffic streets is considered necessary in Chicago and no important track is now laid without them.



Present standard Chicago rail fastening

The rail fastenings used in Chicago tracks are the only part of the track structure as originally designed in which any material change has been made or which has failed to date to have a life equal to that of the other portions of the track. The original rail fastenings consisted of the 9½-in. shoulder tie plate fastened to the tie with two lag screws, the outside of the rail base resting against the shoulder. The rail was held down by means of two screw spikes 6½ in. long with diameter varying from ¾ in. to ½ in. and having a head about 2⅛ in. in diameter which had a direct bearing on the rail base.

Careful tests of the holding power of these spikes were made and from all indications the fastening was of sufficient strength properly to perform its function. However, after a number of years of service in track carrying heavy cars at frequent intervals, they began to show signs of failure and a heavier fastening, shown in an accompanying drawing, was adopted in their stead. The failure of the old type fastenings to come up to expectations was not due to lack of holding power so much as to the fact that the head became bent backward, thus allowing the base of the rail a considerable amount of play, which in the course of time wore away both the screw spike and the plate.

In the case of old-style screw spikes which have been in the track for a number of years, a noticeable amount of corrosion has taken place. In some cases this has gone so far that the spike is very materially reduced in diameter and shortened in length, so that the holding power of the spike is reduced to practically nothing. It is interesting to note that the corrosion of a screw spike in an untreated tie after about ten years' service resembles very closely the corrosion that took place in two and one-half years in a similar screw spike used in a tie treated with zinc chloride.

The new fastening that has been adopted has so far overcome the defects of the old one and up to the present time has developed no failings of its own. This fastening consists of a 7½-in. x 10½-in. x ½-in. shoulder tie plate fastened to the tie with two lag screws, the outside of the rail base resting against the shoulder with the rail held down by three sets of clips and screw spikes. The screw spikes used are 7¼ in. long and vary in diameter from ⅞ in. to ⅝ in. The head of the spike is 1⅜ in. in diameter, with a spherical surface on the underside that fits into a cup in the top of the rail clip, thus forming a ball and socket connection with the clip, and insuring a firm bearing between the spike and the clip even if the spike is not driven exactly on the perpendicular. The clip is 2½ in. x 2⅝ in. and varies somewhat in thickness, the thicker or outer end resting on the plate and the other end on the base of the rail. One of these clips is placed on the outside of the plate and the other two on the inside to help counteract the tendency of the 9-in. rail to tip outward under heavy traffic. This fastening is shown herewith and is proving very satisfactory, some of them having been in place for about nine years without showing indications of weakening.

Due to the weakness that developed

with the old fastenings it has been necessary within the last two or three years to renew the fastenings on the older and heavier traffic streets. This is done by removing the paving, chipping out the concrete along the rail, removing the old fastenings and placing the new ones on the old ties, reconcreting and replacing the paving.

It has been the practice on all of the heavier types of track to weld the rail soon after it is laid, preferably before traffic is allowed on the track. When the rails were first laid they were fastened together by a pair of short two-bolt joint plates to hold them in place during construction. As soon as the concrete had properly set (seven days for all solid concrete types) the joints were electrically welded.

The welded joint used up to and including 1920 was that known as the Lorain weld which was placed with the apparatus furnished by the Lorain Steel Company. About 125,000 original joints were applied to the types under consideration up to and including the year 1920. The use of the Lorain weld was discontinued after 1920 due to the fact that practically no extensions were being built and hence the amount of work in prospect was so small that the rental of the large amount of apparatus necessary to install the Lorain joint made its continued use uneconomical. Since 1920, seam welded joints have been installed by the companies' own men with the arc welding machine supplied by the Rail Welding & Bonding Company. These joints have been installed too short a time to tell how they will work out, but so far they seem to be giving satisfactory service.

The tie rods used on all types of track are 2 in. x $\frac{5}{16}$ in. x 5 ft. $\frac{1}{8}$ in. They are forged or rolled from a single piece of steel or iron and have 1-in. round threaded terminals with two nuts on each end. Tie rod holes are punched at intervals of 6 ft. along the rail, except that a tie rod hole is always punched 2 ft. from the ends of each rail. The tie rods in use at the present time are practically identical with those originally used, the service rendered by these having been so satisfactory that no change has been found necessary or desirable.

The rail section used on the street railways of Chicago is a special 9-in. section known as the Chicago section. It is shown on page 446. This section is specified in the ordinance as the section of rail that the companies must use on all heavy traffic streets. It has proved to be very satisfactory and the great majority of the rail originally laid is still in place. It has only been necessary to make a complete rail renewal on one continuous stretch of double track about $\frac{1}{2}$ mile long on Wabash Avenue, one of the heaviest traffic streets leading out of the downtown district. This rail had given about fourteen years of service when removed. In addition to this rail renewal, a number of stretches of track at heavy stopping points have been rerailed, and a considerable amount of the old rail has been cut out in short pieces in connection with the rewelding of badly broken joints.

Vehicular Traffic Important in Rail Wear

Such investigations as have been made in Chicago on the relation of wheel passes and tonnage to rail wear seem to indicate that there is no fixed relation existing under Chicago conditions. After the new types of track had been in service for about five years an extended survey of rail wear conditions was made, and the data compiled in connection with the number of cars that had passed over the rail, the comparisons being made on the basis of the number of car passes for $\frac{1}{64}$ in. of rail wear.

The result of this investigation showed such a wide variation in the rail wear on the streets considered that a further study was made of the local conditions, with results that seemed to show conclusively that vehicular traffic was a very important factor in rail wear. This vehicular traffic varies so greatly with the seasons, building conditions, etc., that it is very difficult to get accurate data on its kind and amount except by detailed observations over a long period of time. Owing to this difficulty the study was not carried far enough to make possible an estimate of the amount of rail wear due to each kind of traffic.

The great variation in car passages per $\frac{1}{64}$ in. of rail wear may be seen by comparing the results found on streets "A" and "B." The track on both of these streets was of the solid concrete type laid in the same year and examined after about five years of wear. On street A the average number of car passes per hour for a twenty-hour day was eighty-two, or considerably more than one per minute during the hours of operation, while on street B the corresponding figure was ten car passes per hour or a car about every six minutes. An examination of the rail wear on these two streets showed that on street A (heavy traffic) it required 286,800 car passes to wear the rail $\frac{1}{64}$ in., while on street B (light traffic) the corresponding figure was only 66,400 car passes per $\frac{1}{64}$ in. of the rail wear. In this connection it should be noted that while the empty cars on the two streets did not differ greatly in weight, the average load carried on street A was undoubtedly much greater than that carried on street B.

Further examination of these streets, however, revealed the fact that on street A the headway between cars was so short that heavy vehicular traffic practically never pulled on or off the tracks, while on street B the vehicular traffic on the tracks was very heavy, due to the presence of several large freight yards in the vicinity and to the fact that the section was building up very rapidly and the paving in the tracks presented the best hauling surface of any street in the neighborhood. Almost all of this traffic was carried on steel-tired wheels and the result was that the rails were strewn with sand and stone from the material wagons, which was ground up by the following car and vehicular traffic.

These streets are extreme cases, but they bring out most forcibly the fact that car traffic and loading are by no means the only important factors in wear of rail laid in paved city streets. An examination of Fig. 3 offers further proof of the important rôle that vehicular traffic plays in street railway rail wear. The wear shown on this section is entirely due to vehicular traffic, as the rail in question was laid in a paved street as an emergency track and was used only at very infrequent intervals by an occasional car. On the other hand it did carry a large amount of heavy freight traffic moved on steel-tired wheels.

While the foregoing data are of value as giving the experience of Chicago with its track, they give little of value for figuring future rail wear because of the fact that much of the hauling over these tracks was done with steel-tired wheels, while in the future much of it will be done on rubber tires which should have a decided tendency to increase the life of rail in paved city streets.

The large number of car passes

required to produce ¼ in. of wear on street A brings up one factor that was not considered in connection with the above studies, and that is the effect that the constant cold rolling to which the head of the rail is subjected has upon the structure of the steel itself. The data from streets A and B would tend to confirm the contention that the steel in the head of a rail subjected to traffic such as that on street A becomes much harder and more durable than the steel in the head of a rail subjected to traffic like that on street B.

The way in which the greater portion of the rail in Chicago has worn is shown in Figs. 4 to 8. Fig. 4 shows what is perhaps as typical a section as any of the general conditions of Chicago rail. Examined in the street this rail appears much as instead of being nearly parallel to its original position, as in Figs. 4 and 5, is now sloped to the gage line to a considerable extent, and there is no very decided point of division between the top of the head and the side of the throat. The wheel flange is now running on the lip of the rail to such an extent that the bottom of the groove is considerably increased in width.

Fig. 7 shows a further increase in wear. The back of the head is worn so thin that it is beginning to bend down slightly, while the flanges have cut the throat down to below its original depth, and in consequence the lip is weakened to such an extent that it shows considerable downward bend under vehicular traffic.

Fig. 8 shows the same type of wear as Fig. 7 but to a considerably increased extent. The gage line is

In connection with Fig. 9 especial attention is called to the extra metal under the back of the head on the Chicago section. This metal does not appear in most high girder rail sections, but its great value during the later life of the rail is well brought out in this case. The combination of this metal with the rest of the metal in the head gives a section quite similar to a high tie rail such as has long been used to carry heavy cars in open track. The cutting away of the lip of the rail made it of no value in paved streets, but as far as safely carrying the cars was concerned it could still fulfill its purpose. If this metal had not been under the head of the rail the head would undoubtedly have bent down much sooner and more abruptly, and this would have left so small an amount of really useful metal in the

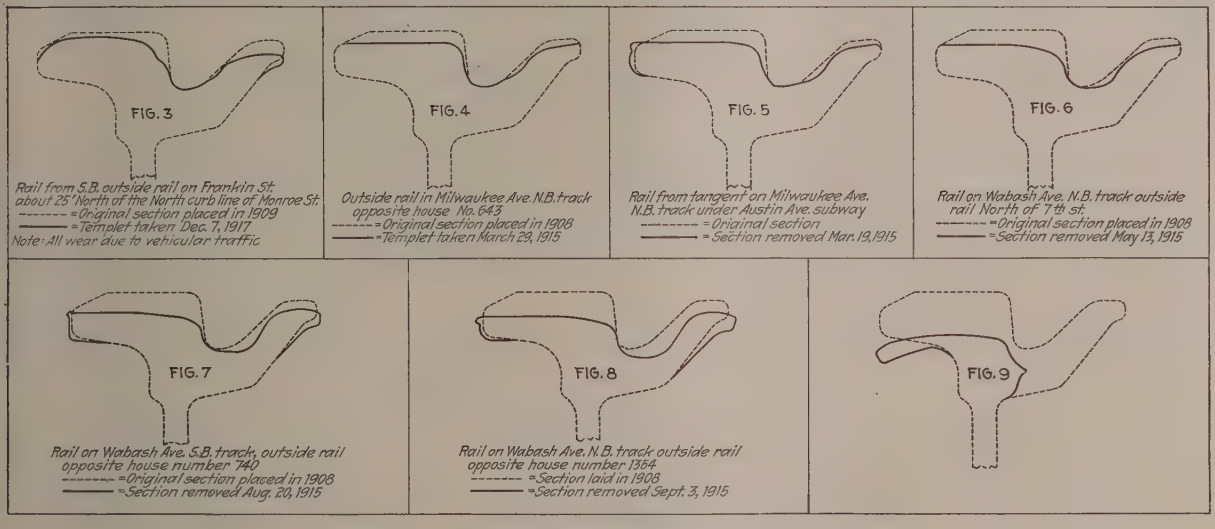


FIG. 3
Rail from S.B. outside rail on Franklin St. about 25' North of the North curb line of Monroe St.
------- = Original section placed in 1909
——— = Templet taken Dec. 7, 1917
Note: All wear due to vehicular traffic
FIG. 4
Outside rail in Milwaukee Ave. N.B. track opposite house No. 643
------- = Original section placed in 1908
——— = Templet taken March 29, 1915
FIG. 5
Rail from tangent on Milwaukee Ave. N.B. track under Austin Ave. subway
--------- = Original section
——— = Section removed Mar. 19, 1915
FIG. 6
Rail on Wabash Ave. N.B. track outside rail North of 7th st.
------- = Original section placed in 1908
——— = Section removed May 13, 1915
FIG. 7
Rail on Wabash Ave. S.B. track, outside rail opposite house number 740
------- = Original section placed in 1908
——— = Section removed Aug. 20, 1915
FIG. 8
Rail on Wabash Ave. N.B. track outside rail opposite house number 1364
------- = Section laid in 1908
——— = Section removed Sept. 3, 1915
FIG. 9

Nature of rail wear as experienced in Chicago surface track

when laid except that the length of the bevel at the back of the head is not quite as great. The illustration shows, however, that the gage line has been worn back to some extent, that there is a slight wear on the lip of the rail opposite the gage line due to the bearing of wheel flanges, and that the top of the lip is worn down. This latter wear is due to vehicular traffic and not to wear from cars, and is evident to some extent on almost all Chicago rail.

Fig. 5 shows additional wear but with the general contour much the same except for a slight flow of metal at the back, which is occasionally seen when the head is nearly worn down to the edge of the bevel.

Fig. 6 shows a more advanced state of wear. The top of the worn rail now worn down well toward the original bottom of the throat, the back of the rail head is considerably bent down, while the lip is so weakened by flange wear as to be decidedly bent.

Fig. 9 shows the Chicago section entirely worn out. This rail was taken from a stopping point in a very heavy traffic street, and until shortly before its removal appeared about as other well worn rail when viewed from the top. Shortly before its removal a crack appeared in the bottom of the throatway between the head and the lip. The rail was removed and found to be in the condition shown here. At the time of its removal this rail was still carrying its heavy traffic in a satisfactory manner.

rail head that the rail would probably have become unsafe for operation and would have been removed for this cause long before it was necessary to remove it on account of the broken lip. This rail gave about ten years of service at a stopping point on one of the heaviest lines in the city.

In the year 1921 the shape of the standard Chicago section was changed slightly, the principal difference being that the head of the rail is made the arc of a circle instead of a straight line as in the old section. This has increased the weight about 1 lb. per yard. None of this rail has been in the track long enough to show how it will work out under traffic.

By far the greater part of the

track laid in Chicago since 1907 has been paved with dressed granite block. The following kinds of pavement have, however, been laid to some extent: creosote block, creosote block with a granite stretcher along the rail, and vitrified paving brick.

Whenever possible the companies pave their right-of-way with redressed granite block unless the vehicular traffic is so light that a much cheaper pavement can be used. The type of granite block used has remained unchanged from 1907 to date, but the method of laying the block has been changed from time to time. The granite blocks used are 5½ in. in depth. In the earlier years of the work these granite blocks were laid on a cushion of bank sand and sealed with a pitch filler, but this did not prove to be satisfactory as the slight motion permitted in the rail, by the loosening of the fastenings used in this early track, produced a pumping action which pumped out the sand during wet weather and allowed the stone along the rail to settle. The first step taken to overcome this difficulty was to change the bedding cushion along the rail from bank sand to dry mortar and grouting the strip along each side of each rail, paving pitch being used on the portion of the track not grouted. This practice was followed for a time, but eventually the standard method came to be the use of a dry mortar bed under all of the block and all of the block grouted. This method is still followed, but asphaltic cement sometimes used replaces the cement grout.

As the companies had an immense number of old granite blocks as salvage from their old tracks, it has always been their practice to keep a force of granite block cutters at work redressing the larger and better blocks for further service. These redressed granite blocks are used on streets having lighter vehicular traffic and they have given service equal to that of new blocks in similar locations. These blocks are laid exactly as new blocks except that because of their shorter depth the concrete under them is brought up slightly higher. About six more blocks are required per square yard with redressed block than with new block.

This granite block pavement has given excellent service in every way except for the settlement along the rail previously referred to. This one trouble has been almost entirely overcome by the use of the mortar bed and cement grout or asphaltic cement binder.

The companies lay creosote block only on streets where it is required by some special ruling, as they consider dressed granite by far the best pavement. A considerable amount of creosote block pavement has been laid, however, using a block 3¾ in. wide by 4 in. deep by from 5 in. to 10 in. long. The method of laying these blocks has been exactly along the line followed in laying dressed granite block, including most of the changes in the method.

Creosote block pavement has not proved very satisfactory in the tracks, as the blocks are not strong enough to carry the heavy loads that they have had to carry when laid next to the rail. The present practice, in nearly all cases where creosote block is required, is to lay a stretcher course of granite block along each side of each rail and pave the balance of the right-of-way with creosote block.

Brick pavement has been used very little in recent years and never anywhere except on streets in the outlying districts where the vehicular traffic is comparatively light. Practically none of this pavement was laid in connection with any of the types of track described and none of it has been subjected to very severe traffic conditions.

Surface and Subsurface Drainage Practices

Almost all of the types of track and paving considered in this article are in streets that are paved from curb to curb and properly drained into the city sewers, so that there is little trouble with the water laying on the tracks. Where the tracks are laid in streets which have not yet been permanently paved, no special arrangements are made for surface drainage except that in cleaning up the streets after construction the roadway adjoining the pavement is leveled down to or a little below the level of the track.

The track is all laid with the inside rails of double track at grade and the outside rails ¼ in. lower, the pavement being laid accordingly. The pavement between tracks is crowned slightly so that the tracks naturally drain off on each side to the adjacent pavement.

Comparatively little subsurface drainage has been intsalled in Chicago. Where the subsoil is sand it is not needed, and where the subsoil is clay it has not generally been considered necessary as most of the heavy track is laid in streets that are paved from curb to curb and consequently have good surface drainage. Nearly all street railway tracks are in streets having sewers under them and these have a tendency to lower the water level below the subgrade of the tracks.

Special Trackwork

As brought out in the discussion of tangent track rail, the companies are required by ordinance to use a standard rail of specified section. This rail is used on all unguarded portions of 9-in. special trackwork. A girder guard rail has been designed for use on all guarded track which follows, as nearly as possible, the section of the standard tangent track rail and fishes with it. This Chicago girder guard section weighs 145 lb. per yard and is shown in Fig. 2. All curves are double guarded when the center radius is less than 500 ft., and single guarded when the center radius is from 500 ft. to 1,250 ft.

The special trackwork used on heavy traffic streets is 9 in. in depth and of four types of construction known as types A, B, C and D. These types are described in the specifications as follows:

Type A consists of 9-in. or 7-in. steel castings, into which manganese steel plates or the equivalent are inserted at points of greatest wear. The terminals are made to fish with the abutting rails by grinding to template.

Type B consists of 9-in. or 7-in. manganese steel castings, or the equivalent. The terminals are made to fish with the abutting rails by grinding to template.

Type C consists of 9-in. or 7-in. rolled-steel rails cast steel-bound or cast iron-bound construction, into which manganese steel plates or the equivalent are inserted at points of greatest wear.

Type D consists of 9-in. or 7-in. built-up special trackwork composed of rolled-steel rail sections.

All special work considered here is composed of 9-in. switches, mates, and frogs of one of these four types, connected by one of the standard 9-in. rails, or else it consists of 9-in. curved rail only. In the following discussion and tables, where all the switches, mates and frogs are of one type, the special trackwork is referred to as A, B, C, etc. Where part of the pieces are of one type and part of another the special trackwork is referred to as B & B, B & C, etc., the letters indicating the types of the special pieces in the layouts.

Table III is based on an analysis of 443, 9-in. layouts (crossovers not included) which were placed in all parts of the city by all companies during the years 1907, 1908, 1909 and 1910. These are all of the 9-in. layouts that were installed in those years, except about twenty-five that were not included due to certain special conditions that prevented their being properly tabulated with the other layouts.

In Table III the first column shows the number of layouts of each kind as described above. The record column shows the percentage that the number of layouts of each type bears to the total laid in those years. The third column shows the total number of feet of track contained in the layouts of the different types. The fourth column shows the percentage that the feet of track in the various types bears to the total number of feet.

TABLE III—STATISTICS ON LIFE OF SPECIAL TRACKWORK

Type	Number of Layouts	Per Cent of Total	Number Feet Track	Per Cent by Feet	Average Feet per Layout	Average Life of Layouts Years	Months
A	15	3.39	1,793.9	0.94	119.6	11	5
B	140	31.60	83,188.6	43.56	594.2	9	4
C	20	4.51	3,623.0	1.90	181.1	9	8
*D	105	23.70	20,301.5	10.63	193.3	10	11
A and B	103	23.25	55,264.3	28.94	536.5	10	2
A and C	4	0.90	1,575.2	0.82	393.8	9	10
B and C	48	10.84	22,565.5	11.81	470.1	9	10
B and D	8	1.81	2,682.0	1.40	335.2	10	2
Total	443	100.00	190,994.0	100.00	431.1	10	1

* Nearly all plain curve layouts.

It should be noted that the percentages as shown in the second and fourth columns differ very materially, especially in the first half of the table. The percentage by layouts is much larger for types A, C and D than the percentage by feet while the reverse is true for type B, even though type B has the largest number of layouts of the four. This is because there are not only a larger number of type B layouts but a very large percentage of them are large layouts, many of them being in the heart of the business district.

The fifth column shows the average number of feet of track in each type of layout. It was obtained by dividing the figures in the third column by those in the first column. It should not be understood, however, that the individual layouts of each type are all of about the same size, for this is not the case. Type B, for example, contains layouts varying in length from less than 80 ft. to more than 1,800 ft.

The sixth column shows the average life of layouts for each type. This life was obtained by adding up the life of all the layouts of each type and dividing by the number of layouts. The age of each layout was taken as the time from its installation to the time when the layout was sufficiently worn so that it was necessary to replace at one time at least a standard single-track crossing or its equivalent. No account is taken of any minor replacements that may have been made before or any life remaining in the layout after the renewal of an amount equivalent to or greater than a standard single-track crossing.

Of the 443 layouts considered there are a few in which the equivalent of a single-track crossing has never been renewed at one time, although several small amounts renewed at various times might, if taken together, equal that amount. These layouts are nearly all on the list of those requiring renewal in the near future, so that for the purpose of this tabulation they were considered as having been renewed as of Jan. 31, 1922. While this assumption tends to reduce the average life shown in the last column it does so to only a limited extent and has the advantage of compensating for cases where the equivalent of a single-track crossing has been removed but in such small amounts and over such a long period that the layout appears on the record as not having been renewed.

According to the data in the last column, type A shows the longest life, and the second longest life is shown by type D special work. The life of the other types ranges from ten years and two months to nine years and four months, a variation of less than one year.

While type A shows the longest life there are certain other factors that should be considered in this connection. In the first place there are only a small number of layouts (fifteen) and it so happens that with one exception they are all plain crossings and in nearly every case are placed at locations where the traffic on at least one of the streets is quite light. For this reason the traffic over them is probably lighter on the average than is the case with type B and type C, and this probably accounts to some extent for the good showing of type A.

Type D shows the second longest life, but this type also has certain special features that should be taken into consideration. The 105 layouts shown under D are nearly all plain curve layouts and in consequence do not give any idea of what the life of bolted switches, mates and frogs would be. They are shown here to give an idea of the life of curved track with bolted joints, as such track is a part of layouts of all types. It will be noted that the life of such track is greater than the life of any construction except A. There being no special pieces in most of the D layouts listed, it is somewhat difficult to determine when the amount of wear on these layouts was equivalent to a single-track crossing on the other types of layout. No exact rule was followed as the variation in the curves was considerable, but in general curves were included in the list when all of the guard section on one rail of the curve had to be renewed.

The layouts listed as part B and part D contain built-up switches, mates and frogs. The life of these eight layouts compare favorably with the other types.

On the whole the use of type B, or solid manganese construction, was greater than that of any other type. Not only were 140 layouts constructed entirely with this type but it was used in part on 159 other layouts or in 299 of the 443 layouts considered. Eliminating the plain layouts it was used in 299 of 338 layouts.

Flange-Bearing Special Trackwork Now Standard

Most of the layouts considered were not flange bearing, but flange-bearing special work was later adopted as a Chicago standard. After the change to flange-bearing special trackwork had been made, the subject of a proper slope at the ends of the throatways on solid manganese plates was taken up and given careful consideration. The result of this study was a specification that gives plates considerably larger than are used in many cities but which are considered here to be a decided improvement over the smaller plates formerly used.

The following paragraph from the specification for "Throats and Flangeways" on type C insert plates gives a good idea of the way in which the size of the plate varies to fit different conditions:

The floor of the grooves in all 90-deg. or acute-angle frogs shall be level from the guard point to the theoretical frog point and extend beyond the theoretical frog point toward the heel. The total length of the level portion of the floor shall be twice the distance from the guard point to the theoretical frog point. The floor of the grooves in all obtuse angle frogs shall be level in front of and extending an equal distance on each side of the theoretical frog point. The total length of the level portion of the floor shall be twice the distance between the points formed by the intersecting guard and gage lines. Inclines shall begin at the ends of this level portion and slope down uniformly to a depth of 1 in. at the ends of the manganese plate, the length of slope to be not less than 6 in., the intention being that the treads of the wheels will have full bearing before leaving the manganese and before the flanges engage on entering the manganese.

MANGANESE SPECIAL TRACKWORK WELDED SUCCESSFULLY

A considerable amount of work has been done in connection with building up manganese plates by means of the arc welding process. The earlier attempts were not very successful but constant study and experiment by the engineers of the Chicago Surface Lines have brought about a decided improvement. Recent experiments with a manganese coated electrode are giving great promise, some work having stood up for a number of months under exceedingly heavy traffic without any sign of failure. It is hoped that within a short time the company will have developed a process by which it can successfully keep these manganese castings and plates in proper condition.

RAIL CORRUGATION CAUSE STILL UNKNOWN

As in the case of other large cities, corrugation of the rail has been a source of considerable trouble and expense on Chicago street railway tracks. This rail trouble seems to have developed about equally on the solid concrete and ballasted types of foundation and under a great variety of traffic conditions. The period of time in which corrugation develops has varied from a few weeks to several years, and in many cases no appreciable amount of corrugation has developed at any time.

After the corrugations have developed considerably on any stretch of track they are ground off with a grinding machine which is a modified form of the Kerwin grinder.

The standard Kerwin grinders with two grinding wheels at one end were remodeled in the companies' shop by placing two similar wheels at the other end of the machine, and using the motor which formerly operated the two wheels to operate all four. The size of the driving belts was also increased and the shape of the belt pulleys changed, so that all grinding wheels now operate more uniformly and with less belt slipping than formerly. In remodeling the machines the control levers were placed on the inside of the wheels and a seat built at the end of the machine so that one man on this seat could readily operate both grinding wheels on his end of the machine. The position not only enabled the operator to handle two wheels instead of one, but placed him in such relation to the rail that he could watch his work much better than when walking alongside the machine as formerly.

The result of these changes has been that the same electrical and truck equipment now handles four grind-wheels instead of two; that the grinders are more reliable than formerly, due to the change in the belt drive; and that one man now operates two grinding wheels instead of one, and in a more efficient manner, since he is so placed that he can see his work better and is relieved of the physical strain of constantly walking at the exceedingly slow and tiresome rate at which the machine moves.

Handling the Records of 11,000 Trainmen on Chicago Surface Lines

ONE MIGHT suppose that the system for handling the records for as many trainmen as are employed by the Chicago Surface Lines would be complicated and the records themselves voluminous. The records do bulk large, of course, when all material information about each man must be kept and permanently preserved for a total of nearly 11,000 trainmen. However, the system for handling and filing these records makes them immediately accessible.

The records are divided into three groups, namely, men who are in active service, former employees, and those applying for employment. All the information pertaining to one man is placed in a jacket, alphabetically filed. Such data include the application blank, his contract with the company, his yearly record sheets, his accident record, the work sheet during his instruction period, any correspondence pertaining to him, and all necessary record papers. During a man's period of employment his name is entered on one page of a loose-leaf record book according to the division to which he is assigned.

This book is in the hands of the division superintendent and in it is entered anything arising in connection with his service as a trainman. For instance, if a complaint is received at the main office about a conductor, the letter is forwarded to the superintendent of the division in which the conductor works. The division superintendent makes a disposition of the case, a record of which is entered on his books and the correspondence is returned to the general office, where it is filed in the jacket of the employee. The division records are returned and filed yearly in each man's jacket. Thus the complete record of any trainman is available instantly at the office of the superintendent of transportation.

A similar file is kept in the employment office for all applicants. In this case the principal record is the application blank and the references from former employers. Last year 4,808 were allowed to file such applications.

RECORDS OF FORMER EMPLOYEES KEPT IN FILES

The record of a trainman who has left the service is removed from the active files and after all papers in regard to terminating his connection with the company are included, the complete jacket is placed in the inactive files in the office vault. Records of former employees are held in the main office as long as the space permits and then the older ones are removed from the files for permanent storage.

It is often necessary to know quickly whether a man is in the company's employ, or has filed an application, or has terminated his connection. For this purpose a card index is kept for ready reference.

"Educating the Public" in Chicago

Large Newspaper Display and Expert Copy Found to Be Inefficient and Ineffective — Reaching the Car Riders Direct with Brief Messages Has Proved to Be More Valuable Publicity, but the Trainmen Offer the Best Entree to Public Good Will

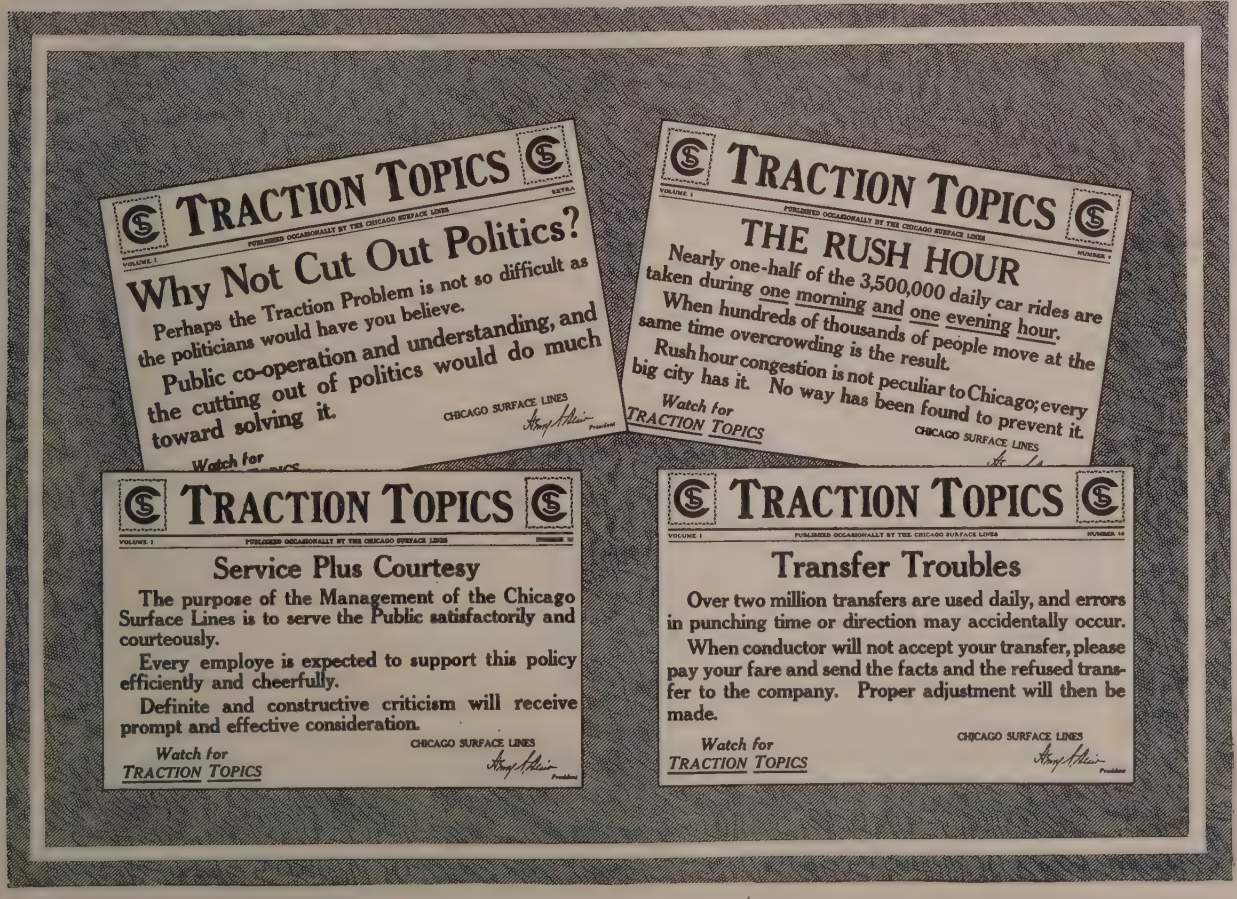
By JOHN E. WILKIE
Vice-President Chicago Railways Company

THE Chicago Surface Lines has had a very interesting, and more or less illuminating, experience with "educational publicity." Its experiments in this field have been conducted with the able assistance of "crowd psychologists," "advertising engineers," publicity experts and common, or garden variety, honest-to-goodness advertising men.

It has experimented with pages and half pages of the "knock-their-eyes-out" variety; quarter pages three times a week; eighty lines, three columns wide, every day; straight reading matter, with and without individual fancy and plain borders, and everything in the way of topographical ingenuity that might be suggested by the skilled, confident and enthusiastic gentlemen who at the moment might be in charge of the mechanical details.

The writer, as a former newspaper man, though not identified with the advertising department, was favorably inclined to this character of publicity as the best method of "educating the public" and creating and crystallizing a friendly public sentiment, but he confesses, with some reluctance, that after several years activity in this particular direction the results have fallen far short of the rosy predictions and confident assertions of the experts. And he has reached the somewhat disappointing conclusion that a sympathetic public sentiment cannot be manufactured by any of the foregoing methods. At least not in Chicago.

It is quite conceivable that in a wide territory embracing small towns and large agricultural areas, where the county seat newspaper is carefully read from the first column on the first page to the last column of the last page, and thoroughly digested, there is a field which may be


TRACTION TOPICS
Why Not Cut Out Politics?
Perhaps the Traction Problem is not so difficult as the politicians would have you believe.
Public co-operation and understanding, and the cutting out of politics would do much toward solving it.
CHICAGO SURFACE LINES
TRACTION TOPICS
THE RUSH HOUR
Nearly one-half of the 3,500,000 daily car rides are taken during one morning and one evening hour.
When hundreds of thousands of people move at the same time overcrowding is the result.
Rush hour congestion is not peculiar to Chicago; every big city has it. No way has been found to prevent it.
Watch for TRACTION TOPICS
CHICAGO SURFACE LINES
TRACTION TOPICS
Service Plus Courtesy
The purpose of the Management of the Chicago Surface Lines is to serve the Public satisfactorily and courteously.
Every employe is expected to support this policy efficiently and cheerfully.
Definite and constructive criticism will receive prompt and effective consideration.
Watch for TRACTION TOPICS
CHICAGO SURFACE LINES
TRACTION TOPICS
Transfer Troubles
Over two million transfers are used daily, and errors in punching time or direction may accidentally occur.
When conductor will not accept your transfer, please pay your fare and send the facts and the refused transfer to the company. Proper adjustment will then be made.
Watch for TRACTION TOPICS
CHICAGO SURFACE LINES

A few samples of the pithy messages told the public in the street cars

intensively cultivated by a railroad or other utility and satisfactory results achieved. A campaign of this character, which has been a scintillating success, I believe, is the one which President Charles Markham of the Illinois Central Railroad has conducted throughout the territory served by his lines.

But our experience, if it means anything, means that the Chicago public, or a very considerable part of it at least, is "hard boiled," cynical and suspicious. This section of the community seemingly accepts with enthusiasm and gives credence to any and every charge against a utility that may be voiced by a self-seeking politician and refuses to take any interest in or be convinced by evidence submitted in courts of record or before commissions, even though that evidence demonstrates the falsity of the wild assertions of the demagogues.

There is another element to be taken into consideration in Chicago. It is a high-pressure community and the readers of newspapers seem to have time only for a glance at their morning and evening daily. Many of them are devotees of particular sections of the paper. They read all of the news in the department in which they are especially interested and give to the remainder of the paper only a hurried and casual once over.

Definite Check on How Many Read Railway Ad

A complete confirmation of this fact was obtained by a little research work a few years ago, following the publication in all of the morning and afternoon papers of a page display relating to a phase of the transportation situation which was rather acute at the time. Our representatives called at every room in three of the largest downtown office buildings and asked two questions: "Did you read the Surface Lines' ad printed in yesterday's afternoon and today's morning papers?" and "How did it impress you?" Out of more than 3,000 individuals who were called upon only about 300 admitted having seen the advertisement, and of those 300 less than 100 had read it. Of those who had read it the majority reached the conclusion that its publication was merely an attempt on the part of the utility to secure the support of the newspaper by buying a large amount of space.

It was these experiments that led to a different, very much less expensive and what has proved thus far to be a much more satisfactory publicity policy. We concluded that the public in which the companies were most interested was the army of car riders. Something more than 1,000,000 people ride twice daily on our lines. Counting each fare-paying passenger and each transfer passenger as a car rider, we had a total of 3,500,000 riders daily. Using the phraseology of the advertising men, here was a "circulation" of 3,500,000 to whom a direct appeal might be made within our own vehicles.

We, therefore, began the publication and display, in 20½x13½-in. poster form, of *Traction Topics*, two copies of which were attached to the windows in opposite corners of the car during the cool weather, and with the approach of summer the form was changed to a card printed on both sides, suspended from the roof over the center aisle. The text was restricted to forty or fifty words.

Information Rather than Propaganda

We abandoned any attempt to "manufacture public sentiment" and devoted ourselves to creating an interest in the property by featuring facts which might appeal to the imagination of the reader or give him something to quote in the way of easily remembered and striking statistics. Most of these related to such simple matters as the number of employees, cars and their cost, magnitude of the transfer business, distribution of riders during the rush and non-rush hours, cost of lighting and heating the system, track mileage, and so on. Interspersed with information of this character were brief statements relating to the uses of transfers, what to do when conductors questioned the validity of transfer slips, how to avoid controversy of one sort and another and similar matters disclosed through the correspondence in files of the complaint department. Several of the posters are reproduced herewith to give an idea of the matters touched upon in *Traction Topics*.

We have daily evidences that *Traction Topics* is widely read, and among other things emphasized by the correspondence from our readers is that the complaint department of our organization is the real barometer of public sentiment. Your treasurer can tell you your exact financial status; your auditor can give you tabulated information about your revenue passengers, car-miles, car-hours, maintenance costs, and so on. But when you want to know how you stand with the public, consult your complaint department.

Nobody knows better than the public utility official that relations with the public are not established by the amiable resolutions or intentions of the management. The real factor in the development of a friendly public spirit is the platform man. Upon his treatment of his passengers, upon his smile or frown, upon his courtesy or incivility, depends the real sentiment of the car-riding public. And this being admitted, it at once becomes evident that in establishing satisfactory relations with the public, nothing is more important than a complete understanding and co-ordination between the complaint and the transportation departments of a great system. One conductor with a grouch can do more to destroy friendly inclination on the part of the company's patrons than the management can do to build up such inclination by a long period of sincere effort and service.

Public Relations a Matter of Employee Relations

In these days, where liberty is taken with even national laws, and there is a spirit of resentment toward restraint of any character, one recognizes that the problem of dealing effectively with offending employees is becoming increasingly difficult. But the writer believes that no public utility can secure either public sympathy or support through any form of publicity unless and until it has educated its trainmen to understand that the reputation of the company is in their hands, and that the disciplinary policy of the organization is sufficiently effective to drive this truth home.

It would therefore seem to be wiser, perhaps, to devote the educational activities of the utility companies to the men who are under their control, rather than attempt to "educate the public." For a properly educated employee can do more in an educational way with the patrons of the company with whom he comes in daily contact than the companies can accomplish with acres of newspaper space, gallons of printer's ink and the expenditure of thousands of dollars in advertising appropriations.

Considerations which have established a power supply unique for degree of reliability and low cost are related. Features of power contract and the engineering determinations embodied in the a.c. and d.c. systems are given in connection with the

Development of Unified Power Supply and Distribution Systems in Chicago

By RALPH H. RICE
Principal Assistant
Board of Supervising Engineers, Chicago Traction

IN THE EARLY DAYS of street railway history in Chicago, all the functions of a power system were performed by horses. The cable system was then introduced and brought its own power problems and troubles, which, like the horse car, are now only memories. Steam power was used on some of the elevated lines, but like the surface lines this has given way entirely to electricity. In a later period all of the elevated lines and most of the surface lines were electrified and operated from steam generating stations providing current at trolley voltage. At that time there were a number of independent companies operating in different parts of the city and having overlapping territories to some extent. Each power system was separate from all others, and there was the usual inefficiency of small plants and duplication and overlapping of distribution lines.

The first great step in advance was in 1907, when most of the independent surface lines were consolidated into two large systems and each of these companies entered into partnership with the city of Chicago. These consolidations were authorized by contract ordinances made between the companies and the city, and provided for a complete rehabilitation of all the properties. This afforded an excellent opportunity, and in fact the necessity, for considering the whole power situation. These ordinances created the Board of Supervising Engineers, whose duty it was to interpret the ordinances, establish standards of construction, prepare plans and specifications and supervise construction and expenditures.

One of the earliest problems confronting the board was to make a decision between purchasing energy from a central station company or producing it in the railway companies' own plants. At that time a number of street railway steam plants were in operation, and the question involved an extension or ultimate scrapping of such steam plants. This question was quite thoroughly studied and a decision was finally made to purchase from the central station company under contracts covering a period of years, and to abandon the steam stations at the earliest practicable date.

At that time the Commonwealth Edison Company was well established in the central station field and was seeking a more diversified load. It was furnishing some energy to the separate railway companies, but the acceptance of the ordinances by the surface line companies necessitated very extensive and rapid increase in the mileage and equipment of their lines, with a consequent demand for additional power equipment. By the purchase of energy the railway companies would be relieved of the necessity of constructing and operating new generating plants to extend or supersede those in use, and this was an item of considerable importance when the railway companies were burdened with such an enormous rehabilitation program. If the central station company could make attractive rates there seemed to be an advantage on both sides. As a result of the study made along this line the decision was finally made to purchase all energy and ultimately to abandon the railway's steam station.

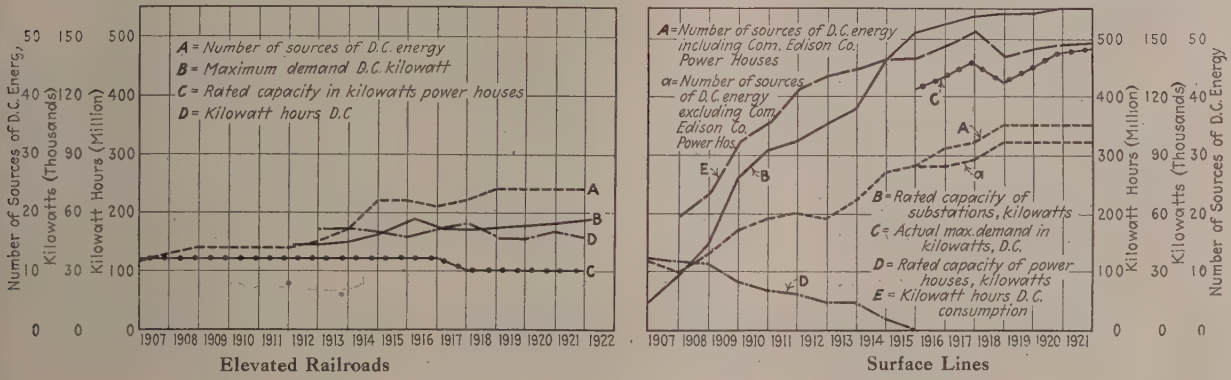

A = Number of sources of D.C. energy
B = Maximum demand D.C. kilowatt
C = Rated capacity in kilowatts power houses
D = Kilowatt hours D.C
Number of Sources of D.C. Energy
Kilowatts (Thousands)
Kilowatt Hours (Million)
1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922
Elevated Railroads
A = Number of sources of D.C. energy including Com. Edison Co. Power Houses
a = Number of sources of D.C. energy excluding Com. Edison Co. Power Hos.
B = Rated capacity of substations, kilowatts
C = Actual max. demand in kilowatts, D.C.
D = Rated capacity of power houses, kilowatts
E = Kilowatt hours D.C. consumption
1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921
Surface Lines

Fig. 1—Growth of power producing equipment and demand of Chicago local railways

The purchase of power from the Commonwealth Edison Company is based upon contracts made between the Chicago Railways Company and the power company and between the Chicago City Railway Company and the power company. Similar contracts are in effect between the elevated railway companies and the C. E. Co. In the early years of the rehabilitation work such contracts were entered into and purchase of power was made under them until 1912 and 1919, when new contracts were made. In both cases, these were made retroactive to Aug. 1, 1909. They involved several features not in the original contracts, such as a sliding primary and secondary scale, provision for change in rate with change in price of coal, provision for limitation of maximum demand in very cold weather, and changes in location of measuring the energy furnished. Subsequently additional contracts were made between the C. E. Co. and each railway company in which they mutually agreed to convert energy for the use of the other. These latter contracts involved only conversion and not the purchase and sale of energy.

In 1913 the Commonwealth Edison Company took over the generation of energy and operation of all substations of the elevated lines, these lines having been joined into one operating organization in 1911. By this arrangement it became necessary for the Edison Company to furnish direct current to the elevated railways. It was also evident that economies would be effected if energy for the elevated roads could be secured from some surface railway substations, and some energy for surface railways from elevated railway stations. As a result of such an arrangement a very satisfactory power supply system has been developed. Its chief operating merits are its reliability and the elimination of overlapping territories in which several independent systems of power supply are situated.

The power contracts and the conversion agreements result in several operating conditions which are interesting. These may be enumerated as follows:

1. Railway company buys a.c. energy.
2. Railway company buys d.c. energy.
3. Railway company converts a.c. to d.c. for Commonwealth Edison Company.
4. Railway company operates joint substations with the Commonwealth Edison Company.

In the first case the railway company owns and operates its own substations and purchases a.c. power at the substation, under the terms of the contract.

In the second case the railway company purchases d.c. power from the Edison Company at stations owned and operated by the latter. In this case the railway company buys the a.c. power under the terms of the contract, and in addition pays for the conversion to d.c. in accordance with the conversion agreement. The companies divide the operating expenses of the substation in proportion to the output used by each.

In the third case the railway company furnished direct current to the Edison Company from stations owned and operated by the railway company. The railway company receives from the power company only a conversion charge, as the a.c. energy furnished to the substation for the Edison Company is not included in the bill to the railway company. As in the second case, the operating expenses of the substation are divided in proportion to the output to each company.

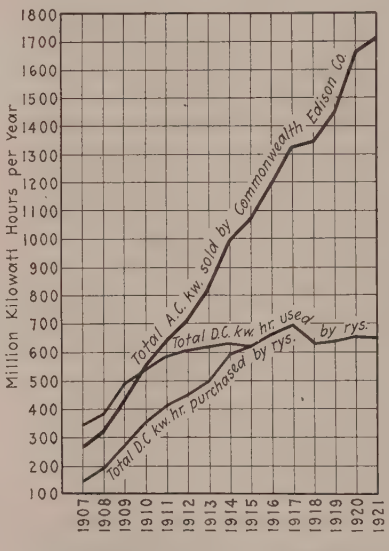


Fig. 2—Energy supplied to railways and total load of Commonwealth Edison Co.

In the case of joint substations now in operation the Commonwealth Edison Company owns the land and building and the machinery for its own output. The railway company owns the equipment for its own output and buys a.c. energy from the Edison Company. The operating expenses are also divided in proportion to the output of the two companies.

These contracts extend to the date of expiration of the railway company franchises, Jan. 31, 1927. The rates are composite, having a primary charge covering fixed charges on investment, taxes, insurance and depreciation based upon the maximum demand for energy, and a secondary charge proportional to the actual cost of production comprising fuel, labor and supplies and based upon the energy actually used. Both of these charges have a sliding scale; that for the primary charge is as shown in table above.

	Per Kw.
Up to and including 30,000 kw. maximum demand	$1.25
Over 30,000 and including 60,000 kw.	1.00
Over 60,000 and including 90,000 kw.	0.91¼
Over 90,000 and including 120,000 kw.	0.87½
Over 120,000 kw.	0.83¾

The secondary charge is, monthly, up to and including 5,000,000 kw.-hr., at the rate of 0.4 cent per kw.-hr.; over 5,000,000 and up to and including 10,000,000 kw.-hr., 0.395 cent per kw.-hr.; and then reducing by 0.005 cent per kw.-hr., for each additional block of 5,000,000 kw.-hr. or fraction thereof, to a minimum of 0.36 cent per kw.-hr. for all energy above 40,000,000 kw.-hr. per month.

To ascertain the monthly maximum demand, the Commonwealth Edison Company selects any three consecutive days and takes the maximum hourly demand during the morning and evening peaks for these three days. The average of these six peaks is taken as the maximum demand. Of course the Edison Company selects the three days which produce the highest maximum. The maximum demand as thus determined becomes permanent until exceeded by a larger one. A new maximum established in the winter months holds over the succeeding summer period when the actual demand is much less.

The computation of the maximum demand is somewhat involved as it is evident there may be several maxima. These are:

A—The main a.c. maximum at railway company stations or joint substations, due to purchase of a.c. power.

B—The a.c. maximum due to the direct current purchased by the railway company at Commonwealth Edison Company stations.

C—The a.c. maximum, due to energy converted for the Commonwealth Edison Company at railway substations.

The maximum demand upon which the primary charge is paid, or the "billing maximum," is the total resulting from adding A and B above and deducting C. This result is the total demand by the railway company for energy used by it. In determining this the three successive days which produce the greatest resultant total

are selected, and of course the values of A, B and C are simultaneous maxima. But the cost of conversion to be paid by the railway and the Edison Company is based upon the actual maxima required for conversion, and these may not be the same in amount or coincident in time with the values used in determining the billing maximum for alternating-current energy as previously explained.

There is one condition which may affect the primary rate and one the secondary rate. When the temperature falls to 15 deg. F., or lower, the excess over the previously established maximum is not to establish a new maximum to be paid for at the above primary rates, but the excess is to be paid for at the rate of 25 cents per kw. per day.

The secondary cost is dependent upon the cost of coal and this is recognized by a provision in the contract, that when the price of coal exceeds $1.90 per ton delivered, there shall be an increase in the secondary charge; and if the price falls below $1.40 per ton there shall be a decrease in the secondary charge. This adjustment may be made every two years. The amount of adjustment in dollars is obtained by dividing by 1,000 the number of kilowatt-hours used during the two-year period, and multiplying the quotient by the difference between the average coal price and $1.90, if an increase, and $1.40, if a decrease.

The conversion agreement stipulates that both the railway company and the Edison Company shall pay for conversion from a.c. to d.c. on the basis of 23 cents per kw. up to and including 10,000 kw. and 18 cents per kw. for all in excess of 10,000 kw. This is a conversion charge only and does not involve the initial cost of the energy. The Edison Company owns and operates all high-tension lines between power houses and substations. Meters are placed at each substation on the incoming high-tension lines for measuring the maximum demand and consumption, and all a.c. energy is purchased by the railway company upon the basis of readings of these meters.

In stations furnishing energy to both the railway company and the Edison Company the operating expenses each month are borne jointly by the two companies, the division being determined by the energy received by each. If the output of the station is all d.c. divided between surface lines and Edison Company for elevated railway use, then the division of expense is made simply on the basis of kilowatt-hours delivered to each. However, if the output is direct current to the surface lines and alternating current of a higher voltage to the Edison Company for general power purposes, then the division must be made on the basis of equivalent alternating-current energy. The railway output in d.c. kilowatt-hours is divided by the efficiency of conversion to get the equivalent a.c. kilowatt-hours. The actual efficiency of conversion for each station is used, which averages 93 per cent. The output to the Edison Company is likewise divided by a conversion factor to reduce it to an equivalent alternating-current value. From some stations energy is furnished to the surface lines, to the Edison Company for elevated railway use, and to

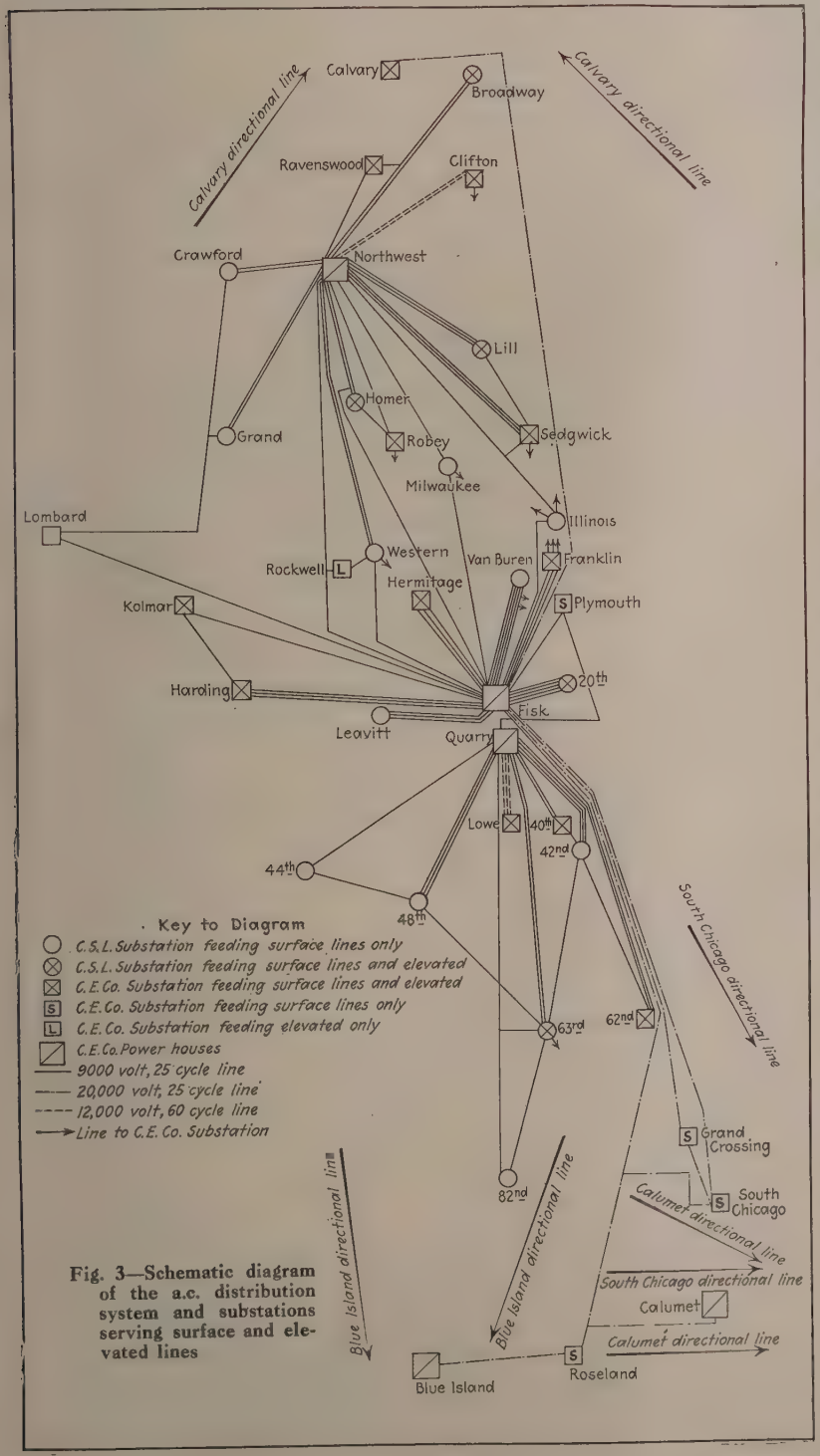


Fig. 3—Schematic diagram of the a.c. distribution system and substations serving surface and elevated lines

TABLE I—SUMMARY OF RATED CAPACITY OF GENERATING STATIONS

In Service December 31, 1921

No. of Station	Date Erected	600 Volt D.C. No. of Units	600 Volt D.C. Kilowatts	9,000 Volt-25 Cycle No. of Units	9,000 Volt-25 Cycle Kilowatts	12,000 Volt-60 Cycle No. of Units	12,000 Volt-60 Cycle Kilowatts	Total No. of Units	Total Kilowatts
Fisk Street		..	.....	12	180,000	2	50,000	14	230,000
Quarry Street	November, 1908	..	.....	4	56,000	2	28,000	6	84,000
Northwest[1]	July 1912	..	.....	3	85,000	3	80,000	6	165,000
Calumet	December, 1921	..	.....	..	.....	1	30,000	1	30,000
Grove Street	October, 1913	..	.....	..	.....	4	14,000	4	14,000
Blue Island	August, 1917	..	.....	..	.....	2	*15,000	2	15,000
Fortieth and State Streets	October, 1913	9	15,000	..	.....	..	.....	9	15,000
Fullerton Avenue	October, 1913	7	5,000	..	.....	..	.....	7	5,000
Loomis Street	October, 1913	5	8,000	..	.....	..	.....	5	8,000
Total Generating Capacity		21	28,000	19	321,000	14	217,000	54	566,000
Edison substation batteries, kilowatt capacity at one-hour rate									23,650
Elevated railway batteries kilowatt capacity at one-hour rate									6,800
Purchased energy under contract from Public Service Company									5,200
Actual generating capacity in service Dec. 31, 1921									601,650
Additional capacity added to Calumet station in 1922									30,000
Total									631,650

* The total capacity of units 6 and 7 at Blue Island is 25,000 kw. but 10,000 kw. has been leased to the Public Service Company.
[1] No. 1 at Northwest Station has two armatures and may be used either as a 25- or 60-cycle machine. At present it is operating as a 60-cycle unit.

the Edison Company for general power purposes. In such cases the railway company pays its share of the operating expense resulting from the division as outlined.

To provide for the demands for power the Commonwealth Edison Company has constructed very large steam generating stations, and each station when constructed was of the most advanced type. Fisk Street station opened in 1903, Quarry street in 1908, Northwest in 1912 and Calumet in December, 1921.

In addition to these plants the company also operates several smaller steam stations and has also some direct-current stations, for elevated railway use principally, and some storage-battery capacity. Table I shows the total generating capacity of the system. It will be noted that both 25 and 60-cycle current are produced.

The four main stations represent an investment of approximately $44,000,000. In addition to this there is about $16,000,000 invested in substations and about $40,000,000 in transmission and distribution lines and cables. Additional investment in other items add several more millions, so that approximately $118,000,000 has been invested in the physical plant to provide electric power and light service in Chicago.

The growth of business of the Commonwealth Edison Company has been rapid and regular, as shown in Fig. 2. The alternating-current kilowatt-hours sold have reached the enormous total of 1,700,000,000 per annum, and of this amount 770,000,000, or 45 per cent, are for railway use. In 1907, both the railway and total loads were much less, and the railway load was then 55 per cent of the total. The decrease in per cent has been due to the steady growth in the retail and wholesale light and power loads, which in recent years have exceeded the railway growth. However, the railway load for surface and elevated lines is the largest carried by any one central station system in the world.

The portion of the total load used by the railways, converted to direct-current kilowatt-hours, is also shown in Fig. 2. It will be noticed that the railway load in 1907 exceeded the total of the Commonwealth Edison Company. At this time and up to 1915 the railway companies generated a portion of their own energy. The lower curve shows the kilowatt-hours purchased from the Commonwealth Edison Company from 1907 to date. The difference between the curves represents the energy produced by the railway companies in their own stations. In 1915 the last railway generating station was shut down and from that date on the two curves coincide.

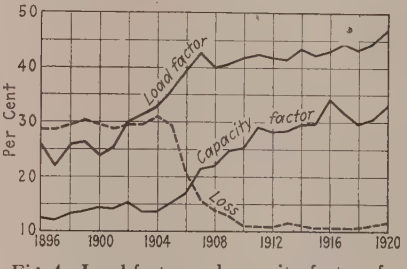


Fig. 4—Load factor and capacity factor of Commonwealth Edison Company

Fig. 1 shows the growth of power-producing equipment and demand for both the surface and elevated lines. The curves show the increase in number of stations, their rated capacity, the maximum demand and the kilowatt-hours produced. The lower curve reducing in value to zero in 1915 shows the decrease in the rated capacity of the railway steam stations. Totals from Fig. 1 have already been shown in Fig. 2.

One of the chief aids in developing energy cheaply is to increase the load factor by building up a load in the off-peak periods of the day and year. The diversified use of electrical energy has been so carefully developed by the Commonwealth Edison Company that they have increased their load factor as shown by the curve in Fig. 4.

In an address by Samuel Insull, delivered at Princeton University in December, 1921, he showed the economic advantage of interconnected systems and diversified load. For comparative purposes the maximum winter day load of the Commonwealth Edison Company in 1902 was prorated on the basis of the maximum winter day load in 1920, and the result showed an increase in the daily load factor from 42.4 per cent to 56.5 per cent. The "capacity factor" of the power system, that is, the ratio of the average kilowatts sold for the year to the capacity has been improved from about 12.5 per cent in 1896 to 33 per cent in 1920. From an economic standpoint, the capacity factor is a better basis for comparison than the load factor, because the fixed charges are based upon the investment in capacity and not upon the power demand of the customer. The improvement in capacity factor is largely the result of adding railway and industrial load, which has increased the load factor and reduced the losses.

High-Tension Distribution by Power Company

The Commonwealth Edison Company owns and operates the high-tension lines from the generating stations to the substations. Fig. 3 is a sketch showing the high-tension distributing system from the generating stations furnishing energy to the railway companies, the Calumet

station not yet supplying any railway load. There is shown the ownership of the substations and the number of lines supplying each station. All railway supply was formerly at 25 cycles, but the 60-cycle supply is being developed and some of the railway load is very satisfactorily carried on these 60-cycle lines. The earlier transmission voltage was 9,000, but the longer lines were subsequently operated at 20,000. The existing 60-cycle railway transmission is at 12,000 volts but a transmission voltage of 33,000 is in use from the new Calumet station. All transmission is by three-phase underground cables. Fig. 4 also shows the ownership of the substations and the disposition of the energy furnished from each.

One of the most important features about this high-tension transmission system is the provision made for the continuity of supply. It will be noticed from Fig. 3 that every substation has at least two lines supplying it, and most of them have several more. In addition to direct lines from the generating stations, the various substations are tied together by lines which may furnish an energy supply regularly or only under emergency conditions. There are also provided ties from these railway stations into other Commonwealth Edison Company substations used for general service other than railway. As a result of this thorough interconnection and the reliability of the generating plants a general interruption to service is absolutely unknown and local interruptions are rare.

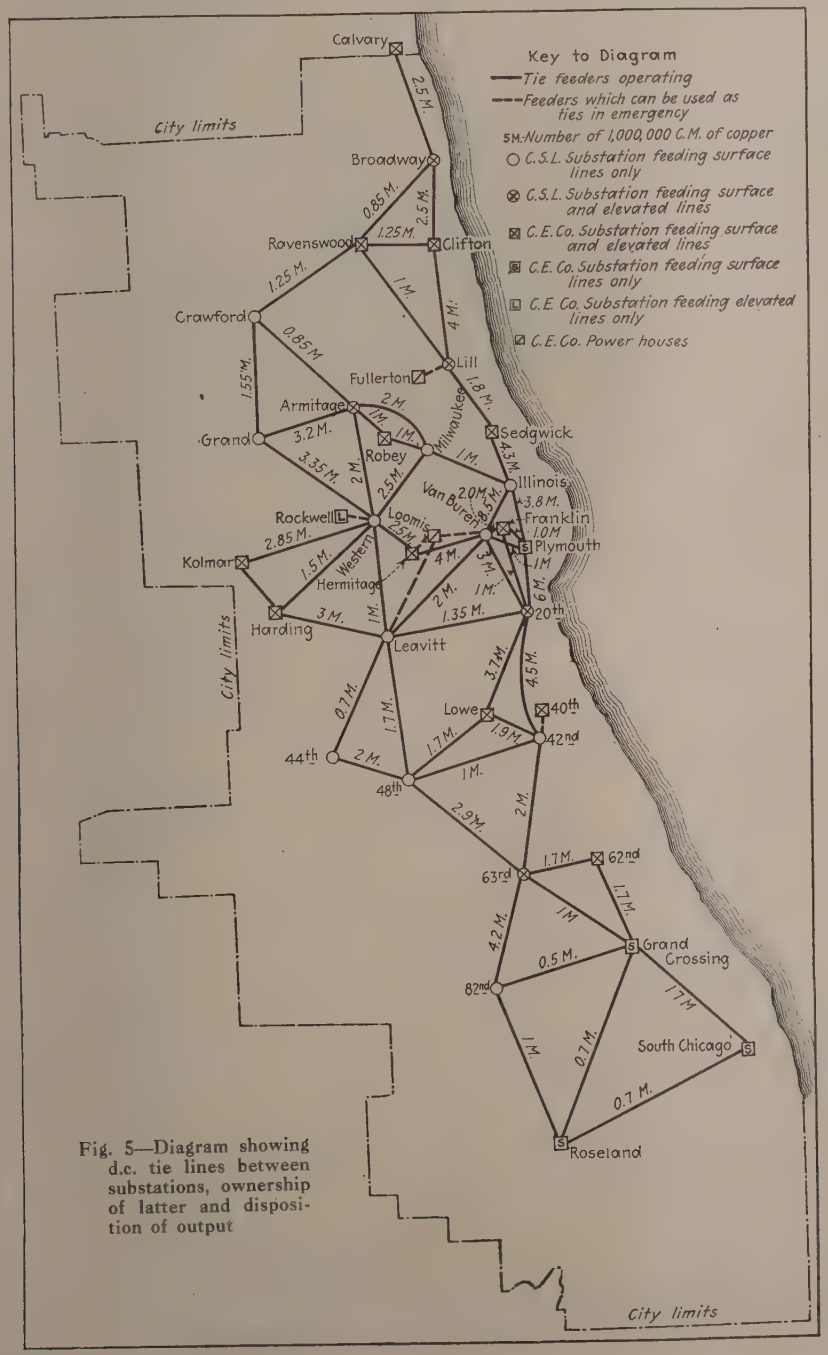


Fig. 5—Diagram showing d.c. tie lines between substations, ownership of latter and disposition of output

The practice in Chicago has been to consider the location of substations first from a general knowledge of where they are most needed on the system. The trolley sections to be put on the new station are then chosen and a graphical calculation of the load center is made by finding the combined "center of gravity" of these loads. If the station location is not the most economical for distribution of copper, studies are made of comparative costs for other locations where company property is available or where real estate may be obtained to advantage. It is found practically that new stations are rarely located where theoretical requirements would indicate.

Chicago substation equipment has become quite standardized and various installations differ chiefly in arrangement of minor details. In the earlier installations traveling cranes and heating equipment were provided. The crane has been omitted in the later stations, as the standard modern machinery is so reliable that it is rarely necessary to make replacements of parts requiring the use of a crane. In fact, the Chicago companies were among the first to omit the crane. Not only does this avoid the investment in a crane, but the building may be made lower and the side walls somewhat lighter, thus making an additional saving. Frequently no heating plant is installed as the waste heat energy from the machines is sufficient to give a comfortable working temperature. The rotary converters used in the early substations were of 1,000-kw. capacity, but the 2,000-kw. unit soon became standard, and was in turn superseded by the 3,000 and later by the 4,000-kw. size. Sixty-seven rotary converters are now in use, divided as follows:

Twelve 1.000-kw. units
Two 1,200-kw. units
Forty-one 2,000-kw. units
Two 3,000-kw. units
Ten 4,000-kw. units

All of the latest stations have

4,000-kw. units. The cost of these large machines is less per kilowatt and they occupy but little more space in the substation, making the square foot area per kilowatt much less than formerly. It is possible to place a 4,000-kw. unit on the same foundation as occupied by a 2,000-kw. unit. Care in design has made this improvement possible, and the later machines contain numerous refinements in design, which in the aggregate improve this class of machine very materially. Standardization of sizes has also permitted the use of standard switchboards, transformers and other auxiliary equipment, and a reduction in spare parts required.

Fig. 5 shows the thirty-four substations furnishing energy to the local lines. In addition to these there is one storage battery station; and also at Plymouth Court substation a battery is in service with rotary equipment. The elevated railway system receives its energy from some of these stations and has in addition two battery stations available for special demands. The ownership of each station and the disposition of its energy output is indicated in Fig. 5. Only the Edison Company stations which furnish energy to the railway systems are shown. Table II gives this information in a more convenient form.

TABLE II—OWNERSHIP AND USE OF SUBSTATIONS

Ownership	Number of Stations C. E. Co.	C. S. L.	Used by Elevated
Commonwealth Edison Company Stations			
1. General, light and power only	41	..	..
2. Elevated only	2	..	2
3. Chicago tunnel	4	..	..
4. Surface and elevated	11	11	11
5. Joint stations, with surface equipment	4	4	..
Surface Lines Stations			
6. Surface only	..	11	..
7. Surface and elevated	..	5	5
8. Battery station	..	1	..
Elevated Lines Stations			
9. Battery stations	..	..	2
10. Elevated and C., N. S. & M. Ry.	..	..	1
Total substations	62	32	21
Steam stations operated by Commonwealth Edison Company	3	3	3
Total stations	65	35	24

The surface line railways have an investment in substation property now in service of about $4,750,000, of which $3,500,000 is in station equipment and the remainder in buildings and real estate.

In Chicago the trolley line is sectionalized by section insulators and each section is fed from a separate feeder panel in the substation. This feeder is often composed of several cables running by different routes and tapping in at different points to a distribution cable on the street, from which feed taps are made to the trolley wire. This "radial" system of distribution is not so economical of copper as a "network" system, in which all the trolley wires form a continuous network and the feeders furnish energy to selected points of the network. But it is difficult to locate trouble in an extensive network of this kind and also difficult to isolate the portion in which the trouble occurs. Some effort has been made in Chicago to utilize the advantages of a network with the radial system by joining adjacent trolley sections through fuses or circuit breakers. Such a method has not been found satisfactory, because it was impossible to adjust the connection so that it would distinguish between a heavy transfer of current from one section to another due to a shift of load (which it should allow) and a heavy flow of current into a section due to short circuit (which it was not intended to permit). The practice at present, therefore, is to provide knife switches, mounted in a pole box, which are normally open, but which may be closed on each end of a section if for any reason the feeders to this section become disabled. Such a plan provides a quickly operative and convenient device for insuring continuity of service, as it is quite unlikely that both the sections adjacent to a disabled section would also be out of service.

In the central portion of the city all feeders are in ducts underground, with laterals up poles for feed taps to the trolley. In the outer portions of the city all distribution is by overhead lines, with a jumper connection to the feed span. All cables are rubber insulated. The clamps holding the weatherproof riser to the pole have an insulating band between them and the pole, and the cable is held in the clamp by a split insulator. This gives three insulations between the conductor and the pole and practically prevents "hot poles."

The basis upon which the positive and negative feeder systems were to be computed was established by the Board of Supervising Engineers. That for the positive system is as follows:

1. The d.c. bus at substations will be operated at approximately 600 volts.
2. An allowance of 40 kw. in substation capacity will be provided for each standard double truck car or its equivalent operated. (The standard car then weighed approximately 26 tons light.)
3. In calculating copper for current-carrying capacity an allowance of 75 amp. per standard car shall be allowed.
4. An average drop of 50 volts will be allowed between the d.c. busbars and the center of load of each trolley section, due provision being made for the lines to take care of emergency cases.
5. The carrying capacity of insulated cables shall be calculated upon the following basis:

In arriving at the basis for kilowatt and ampere requirements extensive tests were made on individual cars in actual operation in different kinds of service. Tests were also made upon groups of from eighteen to seventy-six cars operating on isolated trolley sections of a mile or more in length, by stationing observers to note the cars entering and leaving the section and to take current and voltage readings on the section feeders. The values finally decided upon included requirements for heat and light and operation under winter conditions. The methods of test and computation are fully described in the second annual report of the Board of Supervising Engineers (1908), and in a paper by the writer on "Low Tension Feeder Systems for Street Railways" (Jour. West. Soc. Eng., June, 1910).

A question of considerable importance is the interconnections of stations so that the temporary shutdown of one will not throw out of service all the sections fed from that station. One method of accomplishing this would be to install in every station sufficient copper leading from the adjacent stations to enable the full current capacity of the disabled station to be fed into it from the others. The presence of such trunk tie lines would be highly desirable during an emergency, but would be of no service at other times, except as equalizers between the stations. The investment for such ties would be quite large. Essentially the same results have been secured in Chicago by selecting a number of the more important trolley sections and feeding them from two stations.

The entire trolley network is sectionalized with insulators between the sections. All of the trolley sections on the more important traffic lines are fed from two or more sub-

stations. These "tie lines" are so proportioned that on the whole system, in case of a shutdown of some of the stations, those remaining in service could carry the load through the tie lines. In all cases these tie lines are uniform size cables running through from one station to another, with the load for the trolley section tapped off somewhere between. The amount of emergency current drawn over the tie lines is regulated by the resistance of the cables and by voltage control at the stations—a lowering of voltage at a station throwing more load on adjacent stations. This tie-line feeder system represents in a measure a factor of safety necessary for successful operation. The number of tie lines varies with the importance of the stations and the density of traffic on the individual section fed from them.

Fig. 5 shows the direct-current tie lines between stations furnishing energy to the surface railways in Chicago. Similar ties exist on the elevated system between their stations. The diagram indicates the various classes of substations, as to ownership, and distribution of current to surface and elevated lines. It will be noted that some ties exist between steam stations and railway substations. These ties are not normally in service but are available for use when it is necessary to run the steam stations, as in severe winter peaks. Then the tied-in substation may be relieved of this portion of its load, which will be available for other sections. This plan of providing a flexible and partially duplicate system of feeders has worked well in practice. The feeder system has been so reliable that service interruptions due to lack of power are virtually unknown. This system of the feeders forms the complement of the alternating-current tie lines already discussed.

It is too often the case among electric railways that the return circuit, except possibly for rail bonding, is neglected, while the positive system is carefully planned and constructed. A poorly built negative system does not jeopardize life or cause delays to the same extent as similar neglect in the positive system, but elements of danger and loss are present which are of great importance. With these thoughts in mind the Board of Supervising Engineers determined to make the return circuit of the best type possible, by the following means:

1. Utilizing the full conductivity of the rails, and making the rail joints equivalent in conductivity to that of the rail.
2. Providing for full conductivity through the special trackwork.
3. Providing additional return conductivity so as to keep the potential gradient on the track to a fair value, and the maximum drop within the limit set by ordinance. (This also limited the current density in the return circuit.)

The first was accomplished by electrically welding the rail joints, which produced a conductivity through the joints somewhat in excess of an unjointed length of track. Cross-bonds were provided every 330 ft. between all four rails, so that a break in a rail did not materially affect the total conductivity. Each rail of 129 lb. had a conductivity equivalent to 1,500,000 circ.mil of copper. Full conductivity through the special trackwork was secured by installing long bonding cables completely around the special work, with the ends of these cables electrically welded to the straight track on each side of the special work. Each internal joint was bonded with No. 00 pin terminal bonds, and the conductivity of heavy twelve-bolt joint plates was also utilized. An entire piece of track special work may be removed without materially reducing track conductivity.

In addition to the four electrically welded rails, auxiliary copper cables are used on every street. In the majority of streets one 1,000,000-circ.-mil cable is buried between the tracks, and each cross-bond is connected to this cable. This auxiliary cable continues through the track special work and is tied solidly to the special bonding cables referred to above. On some of the less important streets a 500,000-circ.mil cable only is used. Near substations the amount of copper is increased, so as to keep the current density in the return circuit within a maximum value allowed. This has the effect of limiting the potential gradient in the return circuit and so reducing the tendency to produce stray currents. The amount of copper thus used in the return circuit is equivalent to approximately 875,000 circ.mil for each double track.

Before deciding on the types of return circuit construction many tests were made covering various phases of the circuit, such as types of bonds, rail joints and cable terminals. In computing the requirements of the return circuit a map was prepared showing the network of tracks and the distribution of cars. From this a diagram was prepared showing the load in amperes for each side of any mesh in the network. The current must of course return to the station from which the corresponding positive feeders are run. A preliminary estimate was made of the probable amount of copper required on each street in addition to the rails, the resistance of each mesh of the network was determined, and the distribution of the current returning to each station was calculated by the laws of divided circuits. The drop in each section was computed and the resultant drop around each mesh was determined. Between two corners of a mesh the drop must be the same by all paths, and if this was not found to be so the current was redistributed. This process indicated in many locations that the current was not properly distributed. At these localities a recalculation was necessary. In this way the copper distribution for the entire return system was calculated. In these calculations average conditions with respect to the return of current to the negative buses at maximum load were approximated as nearly as possible. But on account of changes in distribution with each extensive rerouting or change in stations, it has been necessary to make studies of various localities from time to time.

TABLE III—INVESTMENT IN POWER PROPERTIES FOR RAILWAY USE

	Generating	Substations	Distribution	Total
Commonwealth Edison Company	$19,800,000	1,125,000	18,000,000	38,925,000
Chicago Surface Lines	.....	4,750,000	13,500,000	18,250,000
Elevated Lines	4,500,000	425,000	3,625,000	8,550,000
	$24,300,000	6,300,000	35,125,000	65,725,000

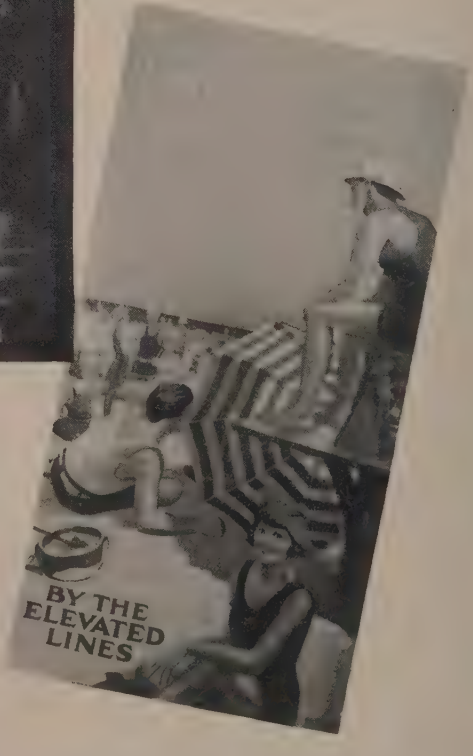
The investment of the surface lines in the positive and negative feeder system is about $13,500,000, including duct and pole lines, all cable and trolley wires and all equipment necessary, outside of the substations.

The investment in railway power properties now in service may be summarized in table III.

The allocation of the Commonwealth Edison Company investment in property for railway use was made upon the basis of the energy furnished as compared to the total, and upon the equipment required. While it is an estimated portion of the total it probably represents a fair value of investment involved for railway use. The investment values given are for equipment now in service.

Chicago Elevated Vies with London Underground in Beauty of Traction Posters

MUCH favorable comment has been evoked by the artistic posters now appearing on the stations of the Chicago elevated roads. A well organized campaign has been laid out so that the copy of the posters is varied according to the seasonal activities of the people. The reproductions here are typical of the subject matter utilized. The fact that these posters stand out so markedly from the usual type of advertising which appears on the stations has been an important factor in the attention attracted. They are printed in three colors and measure 39 in. x 77 in.



Typical North Shore Limited train photographed while traveling 65 m.p.h. over rock-ballasted trackway

$1.00 Revenue for $1.47 Investment

By C. E. THOMPSON
Assistant to the President
Chicago, North Shore & Milwaukee Railroad

How the Chicago, North Shore & Milwaukee Railroad Has Been Built Up—Gross Revenue Has Been Increased 350 per Cent in Six Years by a Splendid Improvement of the Physical Property and an Intense Application of Selling—Total Investment Has Been Decreased from $11.80 to $3.76 per Dollar of Annual Gross Revenue

THE Chicago, North Shore & Milwaukee Railroad, now commonly called the "North Shore Line" or the "Road of Service," was organized six years ago (1916) to take over the properties of the Chicago & Milwaukee Electric Railroad Company of Illinois and the Chicago & Milwaukee Electric Railroad Company of Wisconsin. The properties had been operated by federal receivers for eight and one-half years or since January, 1908.

An appraisal of the property at the date of reorganization showed an investment of $12,252,000. The property needed many improvements; improvements in roadbed and track, overhead and transmission lines, rolling stock and power equipment, and improvements in shops and terminals. Most of all it needed improvement in traffic and revenue which would make possible the financing of the improvements in physical property which were necessary to the improvement of the service.

The reorganization plan provided for practically no working capital; business generally was staggering from the early effects of the World War, and the condition of the electric railway industry of the country was such that to obtain new money from the sale of electric railway securities presented a problem of serious undertaking.

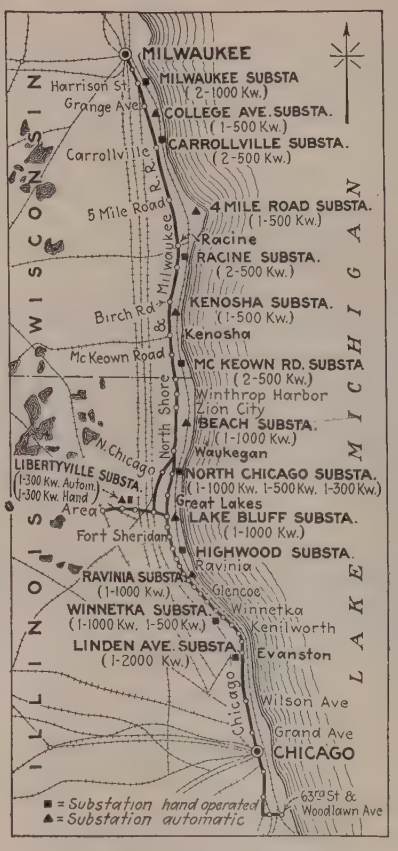
The situation was one that called for an executive with unusual vision and courage and the organizing ability which gets things done. President Britton I. Budd saw at once that with terminals in Chicago and Milwaukee, having a combined population of 3,000,000, the rapidly growing North Shore suburban district between Evanston and Lake Forest, and the growing manufacturing cities of Waukegan, Kenosha and Racine, having a combined population of 200,000, the development of a high-class, high-speed electric railway service would create traffic and justify the necessary investment. While the problem is still in the process of solving, the result at the end of six years is *one dollar per annum increase in gross revenue for each dollar and forty-seven cents increase of investment.* At the date of reorganization the investment for each dollar of annual gross revenue was $11.80. The investment is now $3.76 for each dollar of annual gross revenue. The total investment is now $17,616,000. The gross operating revenue for the year ended June 30, 1916, was $1,038,183; for the year ended June 30, 1922, $4,674,171, an increase of 350 per cent in six years.

Many forecasts were made by financial, engineering and operating experts as to the probable results which could be obtained in the way of increased revenue and traffic, but the actual results have far exceeded what was once considered the wildest flight of engineering imagination. The methods used in building up this property will be treated under two broad headings: First, giving service; and second, selling service.

Giving Service

As previously stated, many improvements to the physical property were necessary before the character of the service and the reliability of the service could be placed on a real service basis. The additions to the rolling stock and the improved shop practices; the additions to and changes in maintenance standards of the roadway, tracks and buildings; and the additional power and transmission equipment and methods employed in maintaining the overhead trolley system are each treated in other articles in this issue of *Electric Railway Journal*, and will be referred to in this article only to show their effect upon the giving and the selling of service.

The financing of improvements to the amount of five and a half million dollars during this period was no small task in itself. The demand for money to finance the manufacturing and other industries directly engaged in producing equipment and munitions for the prosecution of the World War, the rapidly advancing cost of rendering service, the slow and dilatory action of governmental authorities in granting increases in rates of fare, forced many electric railways into bankruptcy and ruined the credit of the industry. And the rates, when money was obtainable, were so high as to be almost prohibitive. For these reasons the money obtained for improvements during this period was from the sale of equipment certificates, from short-term notes secured by first mortgage bonds and from operating revenue. Of the total new investment made, less than 50 per cent is now represented by outstanding securities.



The North Shore Line

The most important part of a railroad is its terminals. When the North Shore line took over the properties, the southerly terminal was at Evanston, where passengers were transferred to the Chicago Elevated Railroads. The Milwaukee terminal was in Second Street, a busy business thoroughfare, with a waiting room in a dilapidated store building. One of the first steps of the new management was to acquire property a block long and half a block wide for a terminal site. A beautiful modern station building was constructed with train sheds and tracks for convenient and efficient handling of the traffic. This station was opened to the public with appropriate ceremonies on Sept. 14, 1920. At the time, the site selected was thought by many to be too far from the business center of Milwaukee. The growth to the west has been so rapid that our terminal is now very near the business center of the city. We have recently acquired practically all of the east half of the block bounded by Sycamore, Clybourn, Fifth and Sixth Streets to provide for future developments of our passenger and merchandise dispatch business.

The Chicago terminal presented an entirely different problem. The purchase of a terminal was entirely out of the question. Negotiations by the receiver for the lease of terminal facilities had been pending for some time, but the obstacles seemed to be insurmountable. The matter was again taken up promptly after the reorganization, and finally resulted in the leasing of all the property of the Chicago, Milwaukee and St. Paul Railway lying between Wilmette and Montrose Boulevard, Chicago. Coincident therewith an operating agreement was made with the Chicago Elevated Railroads for the joint use of the St. Paul property and for North Shore trackage rights over the elevated lines to and around the Union Loop and as far south as Twelfth Street on the south side. Operation under this agreement was

Multiple-unit equipped cars used in merchandise dispatch service

Artistic new station recently opened in Kenosha, Wis.

The Chicago, North Shore & Milwaukee R.R., in keeping with its policy of improving all facilities for the convenience of passengers, on Aug. 12 opened to the public a new station in Kenosha, Wis. With the exception of the Milwaukee terminal, the new Kenosha station is the most imposing on the road and in fact is claimed to be one of the show places of that city. Special attention was devoted in designing it both to obtain maximum utility for railroad purposes and produce a building that would harmonize with the site. The main building is 131 ft. long and 34 ft. wide. Across the tracks on the west side of the line is a platform and a waiting room 48 ft. x 18 ft. The platform will accommodate a five-car train. The building cost was $75,000.

begun on Aug. 1, 1919; and the rights were subsequently enlarged to provide for North Shore operation to Sixty-third and Dorchester Avenue in the Woodlawn district of Chicago. This terminal enables us to deliver passengers, at their pleasure, directly to the Loop, the business heart of this great city, or to the uptown business center at Wilson Avenue, or to the largest south side business center at Woodlawn.

The passenger service, from which 86 per cent of the revenue is derived, has been gradually improved and rearranged to meet the needs of our patrons until there are now five distinct classes of passenger service—city street car service which is operated in Waukegan, Ill., and Milwaukee, Wis.; local interurban service between Evanston and Waukegan at half-hourly intervals, between North Chicago and Milwaukee at two-hourly intervals and between Lake Bluff and Area at half-hourly intervals; express interurban service between Chicago (Loop) and Waukegan at half-hourly intervals; limited interurban service between Chicago (south side) and Milwaukee at hourly intervals daily and half-hourly intervals on Saturdays, Sundays and holidays; De Luxe trains (of which there are six daily) between Chicago and Milwaukee, making stops only at Evanston, Kenosha and Racine. These trains, called the "Badger," "Interstate" and "Eastern," which were recently added to the schedules, make the 86.5 miles in two hours and ten minutes and have proved very popular. They carry dining cars or parlor-buffet cars, are usually three to five car trains, and at least once each week the "Badger" is run in two sections of four cars each. We have found that high speed and reliable service with few stops are appreciated by our patrons.

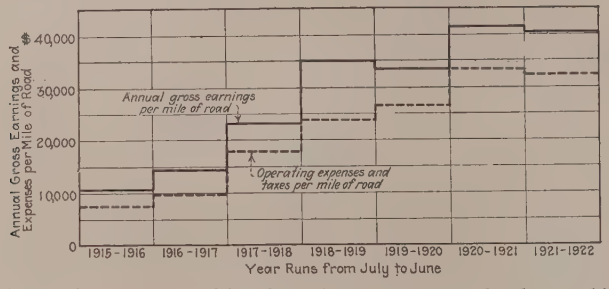
Dining Car Service Is Very Popular

One of our most popular features is the dining car service. Special table d'hôte and à la carte service is now provided on seven trains daily. Everything served on these dining cars from the soup, via the North Shore special steak, to the toothpicks and after dinner mints is the best that money can buy and it is prepared by experienced chefs who know how. Reasonable prices add to the enjoyment of the meals. The most recent addition to the service is the "Eastern Limited," which makes connection in Chicago with the "Broadway Limited" and the "Twentieth Century" for New York and other Eastern points. These trains have parlor cars as well as coaches, and parlor-observation cars will soon add attraction to these already popular trains.

Another feature which is operated for the convenience of our patrons are the concessions and restaurants in our stations. Realizing that the traveling public usually avoids railroad concessions and restaurants for fear of inferior goods and exorbitant prices, and knowing from experience the difficulty of controlling the prices and service when the concessions are operated by outside parties, we have undertaken to operate these as part of North Shore service. A high standard of quality and service is maintained. Where practical, local and nationally advertised brands are

Better view of waiting shelter opposite main station, Kenosha

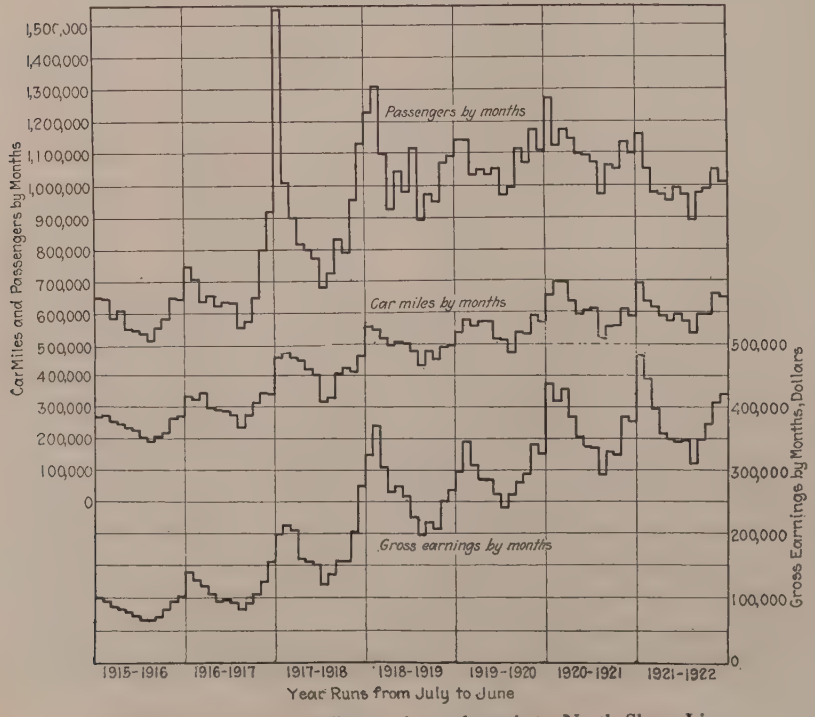
sold at the prevailing local prices. In our Milwaukee terminal station the restaurant is of the most modern design, fully equipped for both table and lunch counter service. A plate lunch is served at 35 cents and a full course dinner at 50 cents. This service attracts not only those traveling via our road, but also draws largely from Milwaukeeans. These concessions now operated in seventeen of our stations produce gross revenue in excess of $300,000 per annum and in addition to the convenience to our patrons, they add a neat sum to our net revenue.



Trend of revenue resulting from improvements and salesmanship

Our city street car service in Waukegan and Milwaukee was as unprofitable as most lines of like character. In 1919 one-man safety cars were purchased for the Waukegan city line and placed in operation early in 1920. Before the cars were placed in service, the idea was sold to the city officials, to the public and to the men who were to operate the cars. Street car fares were being increased wherever possible in an attempt to cover the rapidly increasing cost of operation. We explained our situation frankly and expressed the hope that the one-man safety cars would enable us to give better service and at the same time keep the fare down to a reasonable basis. The trainmen were thoroughly instructed in the handling of this type of car. By the use of these cars the service was increased 90 per cent, the fare was kept down to 6 cents, the traffic was increased substantially and the financial improvement has been quite gratifying. The Wisconsin Railroad Commission has approved of similar operation on our city line in Milwaukee. The cars are being built and will soon be in service.

The passenger service on our branch line between Lake Bluff and Area has never been profitable. We are now having built for use on this line some light-weight interurban cars, designed for operation by either one or two men. The reduction in operating expenses which will become possible by the use of this car will, we believe, make this branch at least self-supporting.



Seasonal variation of traffic, service and earnings, North Shore Line

In 1916 the Adams Express Company was operating on our line and we also did a small amount of carload freight business. The express contract was unprofitable, and the possibilities of carload freight were limited to a small part of the line and consisted largely of sand, gravel and crushed stone, which moved only during the summer months when road building and other construction work was being done. The express company discontinued its service in 1917 and we inaugurated a merchandise dispatch service. This business is handled in express cars constructed for the purpose and the service corresponds with express service without the pick-up and delivery features, although the rates are on a par with the steam road freight rates and the steamboat rates. From a very small beginning this department has developed rapidly until the revenue from this source is more than half a million dollars per annum.

Facilities Provided for Merchandise Dispatch Service

Twenty cars are used exclusively in this service and fifteen additional cars are now being built. Four receiving and delivering stations are provided in Chicago at convenient points. The principal station is at Franklin and Austin Streets near the Loop. On the south side is one on Sixty-third Street near Calumet and one at Forty-first and Union in the Stock Yards district. The north side station is on Montrose Boulevard near Broadway. Cars are operated to the Montrose station and to the Sixty-third Street station. Between Montrose and Franklin stations and between Sixty-third Street and Union Avenue station transfer is made by motor trucks. The North Shore Line owns and operates six 5-ton tractors and fifteen 10-ton trailers for use in making this transfer. Two stations are operated in Milwaukee, the principal one, which is 400 ft. long with track capacity of ten cars, is located on our main terminal property at Sixth and Clybourn Streets. The other is at Harrison Street near the south city limits. Ample station facilities are also provided at Racine, Kenosha, Waukegan, North Chicago

and other points. In addition to local shipments on our line, business is interchanged with other rail carriers and with boat lines in both Chicago and Milwaukee.

Lying west of the North Shore Line in northern Illinois and southern Wisconsin, there is a chain of very beautiful lakes. This territory provides vacation and recreation places for many thousands of Chicago and Milwaukee families. Many have their summer homes on these lakes and many tourists are attracted by the fine fishing in spring and summer and the hunting in fall and winter. The North Shore Line plans to make this beautiful playground much more accessible and bring it much nearer to the cities by extending its service into this region. A start was made this season by providing motor bus service between Kenosha and Lake Geneva, Wis. This service was popular from the start, and before another summer we will establish other lines until the entire territory is adequately served.

Selling Service

Does the live merchant, having selected a good location, installed modern equipment and tastily arranged his high-class merchandise, sit down with folded hands and wait for customers to come to him? Or does the successful manufacturer fill his warehouses with his product and then wait for customers to come to him? No! These men advertise. They send out their salesmen and their sales engineers, who give reasons why they should receive patronage; who explain the superior value of their product or merchandise, their process of manufacture, the responsibility of the men behind their business, their ability to make prompt deliveries; they get in personal contact with their customers and create friendships; they use modern selling methods.

Modern selling methods are as necessary in the transportation business as in the sale of haberdashery, boots and shoes, or farm implements. To build a railroad, equip it with fine cars, provide stations and good service and then sit down and wait for customers will naturally get the same results as the retail merchant or manufacturer gets who uses this same out-of-date method—a bare existence or mediocre living.

Our selling methods will be treated under three divisions, i.e., advertising, sales force and public relations.

We have used various forms of advertising. The most effective medium is by word of mouth from patrons who have been pleased by the service. You know it means something, when traveling men are sitting around the hotel lobby, to have Bill say to John, "Have you used the North Shore Line? That's the best service I know of"—and go into details to support his statement. Our patrons are our best advertising medium. And then we use the newspapers, not only the large dailies in Chicago and Milwaukee, but also the dailies and the weeklies in the smaller cities and towns through which we operate. We use the large outdoor advertising boards in carefully selected locations, most of which are illuminated, and also posters at our own stations and on the Chicago Elevated platforms. We use the street car and elevated car cards and many thousands of folders and time cards annually. We have used stereopticon slides in the motion picture theaters with good results and we have two excellent motion picture films which we use in the theaters and at public gatherings of every kind. These are called the "Green Bay Trail" and the "Pace of Progress," each in its interesting way showing the development of transportation from the Pioneers and the Indians to the highly developed electrically operated service of the North Shore Line. These films will be exhibited at the convention at the North Shore exhibit space.

We also have the "North Shore Bulletin," which is issued monthly and distributed to a large mailing list and also direct to our patrons on the cars. This unique "house organ" is stamped by the individuality of its Scotch editor, and while it bristles dry humor, it also carries a message each month with his philosophy and about some improvement or new service which the road is providing.

Another form of advertising which we have used freely is *paint*. No, I don't mean the paint used on the billboards and posters. I mean the paint used on the cars and the stations, and on the signs and signals along the right-of-way. No money is spent in the maintenance of a railroad to better advantage than that spent for paint. You not only preserve the steel and the wood which is covered, but you show the public that you are up and doing. In addition to the paint we have used shrubs and flowers and grass, and the lawnmower, to improve the appearance of our station grounds.

As I have said before, the most effective advertising medium is by word of mouth. While we have been improving the roadway, adding new equipment, building new stations and improving the service, yes, and raising the rates, we have told our patrons our plans and called their attention to the improvements and explained the reasons for increasing the rates; all the time giving them something to think about and to talk about and letting them know we have transportation for sale.

Main waiting room in new Kenosha station

We believe that advertising pays. And while it is very difficult to measure results directly, we think all the forms of advertising used have produced. But we haven't depended entirely on paint and printers' ink. We have our salesmen on the road calling upon our trade. Our traffic men find shippers who don't know about our merchandise dispatch service. They find booking agents who didn't know the North Shore could handle the properties of a troupe having an elephant and several ponies. They call at stage entrances on actresses who didn't know they could, by using the North Shore service to Chicago, leave Milwaukee after their evening performance and be in St. Louis for rehearsal the following morning. They find many lodges which are pleased to learn that the North Shore has all ready for their use their illuminated emblem to be placed on the front end of their special train. Our traffic men not only find new customers but they keep in touch, both by personal calls and by mail, with those who already know of and are using our service.

Our sales force is not confined to our traffic department, however. All of our employees are salesmen, and especially those who come directly in contact with our patrons, such as our station agents and our conductors. By intelligent selection, careful instruction and close supervision we now have courteous, obliging, well-informed "business-getters" on our trains and in our stations. Supplementing the usual rule books, bulletins and other written instructions, we have frequent meetings with our agents and also with our trainmen at which our plans for new lines of service are discussed, questions are asked and answered and the part our agents and trainmen have in developing and keeping business is emphasized. Our patrons are impressed with the uniform courtesy of our employees, and both the employees and the management are proud of our reputation in this respect.

Public Relations and Employee Relations

The progress which has been made in the development of this property can be attributed in large measure to a very definite policy of fair and liberal treatment of our employees and the public. The road has paid the highest wages conditions would warrant and provided the best working conditions. At the Highwood headquarters a restaurant is provided which serves wholesome, well-cooked food at cost, and a liberal discount is allowed employees at all restaurants and concessions operated by the company. Recreation rooms are provided at Highwood and at the Milwaukee Terminal. A visiting nurse is provided by the company to assist any who are sick or have sickness in their family. A mutual benefit association, to which all employees are eligible to membership, is supported on the basis of the company paying into the fund 50 per cent of the amount contributed by the members. This association pays both sick and death benefits and has proved very helpful. Americanization work among our foreign speaking employees is directed by an expert in this line, assisted by volunteer services from our supervisory force. This work includes teaching of English, instruction in American ideals and standards, sanitation and recreation; our objective being the naturalization of these men until our employees are 100 per cent American citizens.

Organized safety work under the direction of the bureau of safety has had a prominent part in the improvement of the service. This work is so organized that the interest of every employee is enlisted, every suggested improvement in operating practice and in the physical conditions are carefully considered and promptly acted upon. Our standard is service with safety. In addition to its work among our employees, this organization has preached the gospel of safety to all school children and to many clubs and societies in our territory.

All legitimate claims, whether for personal injury, loss or damage, overcharge, or for ticket refunds, are settled promptly and whenever possible on the day received.

During the six years we have obtained new franchises in Waukegan, Lake Forest and Highland Park. Each case involved the acquisition from the city of all or parts of the public streets, for private right-of-way and for extensive improvements in the way of track extensions and the relocation of highways. Negotiations were on a business basis, the public was fully informed as to what the railroad was to get and what it was to give the city in addition to the better service which the improvements would make possible. In two of these cities having commission form of government, the franchises were approved by popular vote.

The passenger fares six years ago were very low, the average being less than 1¼ cents per mile. Rapidly rising costs due to the World War made increases imperative. This involved not only increasing the mileage rates but also the setting aside of commutation rates provided by municipal franchises. Our first step was to increase the rates to 2 cents per mile and eliminate the low commutation fares. Through extended hearings before the state commissions our cards were all on the table face up, the public was fully advised as to both the legal and economic phases of the situation, and the first bridge was crossed in 1917 with little, if any, ill-feeling. Later in 1918 our interstate and Wisconsin intrastate rate was increased to 2½ cents per mile; in September, 1920, to 2.7 cents per mile, and finally in November, 1920, to 3 cents per mile, the rate for Illinois intrastate traffic remaining at 2 cents per mile on account of statutory limitations until July, 1921, when these rates were raised by order of the Interstate Commerce Commission to the same basis as the interstate rates to remove the discrimination against interstate traffic. When our service was extended into Chicago, commutation rates were voluntarily established between Chicago and the Illinois suburban towns on the basis of 1.6 cents per mile for the twenty-five ride ticket and 1 84 cents for the ten-ride ticket. These rates, which are still in effect, average 28 per cent higher than corresponding rates on the steam road between the same stations. All other passenger rates are uniform for the entire line and are now:

Interurban:	
Cash fare	3.3 cents per mile
Ticket fare	3.0 cents per mile
25-ride ticket	2.5 cents per mile
1,000-mile book	2.5 cents per mile
60-ride monthly	1.5 cents per mile
50-ride child's	1.0 cent per mile
City Lines:	
Waukegan	6 cents
Milwaukee	6 cents

Modern business success is accomplished through organization. In addition to the many other problems involved in the rapid development of this property, there was the problem of developing an organization. This was largely accomplished by selecting men from the ranks and training them for superintendencies and other supervisory positions. Through frequent meetings of the executives and supervisory force, the president outlines the policies to be followed. Programs are laid out, all

criticisms and suggestions are considered and each department kept closely in touch with all contemplated changes in service and plans for development of the property. All matters of importance are referred to a special committee or to one of the standing committees for careful consideration and for their recommendation. The more important of the standing committees are the rate committee, which considers all contemplated changes in passenger, merchandise dispatch and freight rates; the authority for expenditures committee, which passes upon all expenditures for additions and betterments to the property, and the budget committee. The work of the A.F.E. committee (as the second is called) has been especially important owing to the fact that the small amount of money available each year had to be expended for those improvements which would be the best from the revenue producing standpoint. When money for improvements depends upon each dollar expended producing 70 cents additional revenue annually, great care must be used in deciding which of the many "necessary" improvements to defer.

The work of the budget committee has also been very important. We are using the budget system for the sixth year for both operating and capital expenditures. Prior to the beginning of the year, each department submits in detail and by Interstate Commerce Commission classification of accounts the amount required each month of the ensuing year to operate that department. These estimates are predicated upon an assumed operating schedule prepared by the transportation department and passed upon by the budget committee. Based upon the same estimated car-miles for each class of service, the committee carefully estimates the operating revenue, and a budget of operating revenue and operating expenses is thus prepared. After carefully considering the estimates of capital expenditures required, the committee determines the maximum total amount that can be financed, based upon the budget of operating revenue and expenses. This committee then eliminates those items of capital expenditures which can best be deferred. After determining in what months the new capital will be expended, the interest and other fixed charges are determined and the income budget is completed. The budget of capital expenditures and operating income are then submitted to the president and board of directors for approval. The actual results are then compared with these budgets monthly, and any over-expenditures promptly brought to the attention of the department responsible. The work of this committee is so carefully done that the actual results for the year are frequently within 1 per cent of the budget estimates.

Our auditing department has worked out a very complete cost accounting system under which the revenues and expenses of various classes of the service are segregated and reports rendered monthly so that each department knows what kind of a financial showing is being made. For example, a report is made monthly covering the operation of the merchandise dispatch service, another for carload freight, one for each of the city lines, one for the motor truck service, one for the motor bus service, etc. Monthly meetings are then held which are attended by the superintendents and the accounting officers at which the results are analyzed, attention is called to any unusual charges, and by the use of charts the general trend of each department is illustrated. This cost system has been very helpful to the management in determining what classes of service are most profitable and along what lines it is best to make developments. It has also had an important part in the education and development of superintendents and others who have been promoted to supervisory positions. To obtain real efficiency those directly in charge must know the cost of rendering service and must also realize that the service must always be just in advance of the requirements in order to create traffic.

In addition to developing our own organization, we have used to advantage various experts who render special service in systematizing the work of our own departments. Among these are the Bureau of Railway Time Service, Western Weighing and Inspection Bureau, Western Demurrage Association, Bureau of Commercial Economics and the Bureau of Safety; also experts in filing, forms and correspondence, in valuation work and in accounting.

Special attention has been given to the elimination of claims. When claims do arise they are disposed of promptly, but it is much better business to prevent them. In addition to the direct effect upon traffic, accident prevention work has a direct bearing upon the efficiency of the organization. Safety and efficiency go hand in hand. We have invested approximately $100,000 in crossing gates and automatic signals to protect the general public, besides the many improvements for the protection of our employees and our patrons. We are spending $150,000 per annum in the maintenance and operation of safety devices. Practically all the work of our merchandise claim department is in the elimination of loss and damage claims. Actual payments in settlement of such claims now amount to less than 1 per cent of the gross.

The North Shore management has the same threefold obligation that every public utility has. The first, the obligation to serve the public, we believe we have met by giving this territory a very high grade, high speed, electrically operated railroad service. The second, the obligation to the employees, has also been met by providing good working conditions and by paying the highest wages which can be justified by the general economic conditions and the earning power of the property. The third, the obligation to pay a fair return to those who have invested their money in the property, has not yet been fulfilled. The investor's position, however, has greatly improved since the reorganization, and the indications are that a fair return may soon be earned, not only on the new capital invested, but also upon the fair value of the property.

Much has been accomplished, but those responsible for the success of the road feel that only the foundation has been laid; that upon that foundation may be built a transportation service meeting every need of the communities served, furnishing employment to many people at fair wages under favorable conditions, and earning a fair return for all those who may become financially interested in the Road of Service.

NUMBER OF TRAINS OPERATED ON CHICAGO, NORTH SHORE AND MILWAUKEE RAILROAD

	July, 1916		July, 1922	
Local Trains	Daily	Sundays Holidays	Daily	Sundays Holidays
Evanston-Waukegan	103	116	71	64
North Chicago-Milwaukee	23	21	36	27
Lake Bluff-Area	36	40	68	68
Express Trains				
Chicago-Waukegan	..	..	59	69
Evanston-Waukegan	..	..	15	4
Limited Trains				
Chicago-Milwaukee	..	..	46	59
Evanston-Milwaukee	30	33	..	..
	192	210	295	291

Comfort, speed, quick acceleration, operation in trains and on elevated structures, through slow suburban territory and fast open country are among the

Requirements Imposed in Designing North Shore Passenger Cars

By H. A. OTIS
Engineer of Equipment
Chicago, North Shore & Milwaukee Railroad

Type of steel passenger car which has proved very successful on North Shore Line

MANY limitations and special requirements were imposed upon the engineers in developing the design of passenger equipment for use on the Chicago, North Shore & Milwaukee Railroad. Part of these restrictions and requirements are readily seen from a brief characterization of the route over which the trains operate. Trains start in the Woodlawn section on the south side of Chicago, travel over the elevated railroads through the Loop district, the Wilson Avenue district and the north side of the city, and then through the fine residential suburbs along the North Shore. Operation is entirely over the elevated structures and tracks leased from the Chicago, Milwaukee & St. Paul Railroad to a point approximately 16 miles north of the downtown Loop district, or to the southern edge of the village of Wilmette, where the North Shore tracks begin. From Wilmette to North Chicago Junction there are numerous suburban towns which result in the necessity for a suburban service along this part of the line. From North Chicago to Milwaukee the route passes through open country and strikes the prosperous manufacturing centers of Waukegan, Kenosha and Racine, covering a distance of approximately 50 miles to Milwaukee, the northern terminal. For many miles the North Shore line parallels the tracks of the Wisconsin division of the Chicago & Northwestern Railroad, which operates frequent, fast, first-class trains between Chicago and Milwaukee.

With the conditions of this route in mind, it will be seen that the North Shore cars must meet the limitations in length, width and height imposed by the clearances of station platforms and curves on the elevated structure, which was built many years ago without thought of serving other than local service. For this reason the North Shore cars are narrower and shorter than they otherwise would have been built. The vestibule posts have also had to be set in, in order to assist in gaining the greatest length while still meeting the elevated clearances. It is also necessary that the North Shore cars be limited to a certain weight per axle, and certain spacing of the axles to prevent overloading of the elevated structures. On account of the suburban operation at the south end of the system numerous stops must be made, and this necessitates that the cars be equipped with sufficient motor capacity to permit of

rapid acceleration, in order to keep up a high average schedule speed. This matter of high schedule speed for the entire run also necessitates that sufficient motor capacity be provided to operate at fairly high maximum speed through the open stretches of track at the north end of the system.

As the North Shore Line is in direct competition with the very excellent service of the Chicago & Northwestern Railway, the running time on the North Shore must compare favorably with that of the steam railroad time in spite of the suburban service limitations at the south end, in order to obtain its proportion of the business. This means that the cars must attain a speed of 65 m.p.h. Besides speed, the North Shore must compete with the steam railroad in the matter of comfort and convenience to passengers and in safety of operation.

The amount of traffic and the frequency of trains was also another matter which had to be considered in the design of this equipment. At first a considerable number of one-car trains were operated and this make-up was maintained by shortening the time between trains until the point was reached where there were limited trains leaving Chicago and Milwaukee every hour. As the traffic further increased more cars were added to the trains until now there are practically no single-car trains, and many of them run with four and five cars. Operating four and five-car trains at a speed as high as 65 m.p.h. obviously introduces many problems to be taken care of in the way of buffing stresses, and stresses that would develop in the event of collision or derailment, which are not so important in single car operation.

Heavy Steel Framing Produces Safe and Quiet Cars

A great deal of study has been devoted to the development of a proper design of the steel framing on the North Shore cars to prevent telescoping in case of collision and to make these cars as safe as possible in every way for the passengers riding in them. The sub-frame has been developed along the general lines which have proved satisfactory in heavy steam railroad service, having continuous center sills form end to end of the car, which are heavily reinforced at the ends. The vestibule framing has also been very carefully worked out to give as much strength as possible to the vestibules

Train door, heavy end construction and equipment

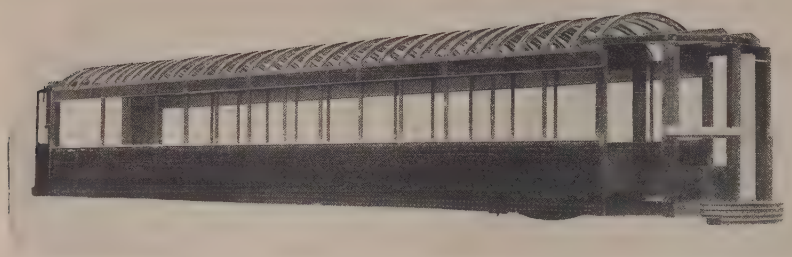
to prevent crushing in. The vestibule corner posts, body corner posts, train door posts and bulkhead arch posts are all tied together at the top by means of steel members and a heavy steel cover plate. The steel cover plate also forms the vestibule ceiling. This steel frame construction has proved very satisfactory, and it is believed that it meets the conditions for which it was designed.

In the selection of air brake and electrical equipment and in the building of the trucks no expense has been spared to obtain the safest and most reliable equipment known to the art. Another important matter on which a great deal of time was spent was the matter of riding qualities. It has often been said that the average interurban railroad cars do not ride as easily as the cars on the steam railroads, and various causes have been assigned for this. The management of the North Shore Line has insisted upon obtaining trucks which would ride as easily as steam railroad equipment. This has been accomplished by paying particular attention to the design of the trucks and springs.

There is a tendency among many spring and truck manufacturers to provide springs which are somewhat too stiff. This is the result of insistence that the spring shall stand up without sagging for a long period of time, and also because there is a tendency for cars to weigh more than is estimated before construction, which causes manufacturers to make rather generous allowance in dimensioning the springs in order to be on the safe side. Also, the live load variation on electric cars is so large in proportion to the weight of the cars light that it is rather difficult to design springs which will provide easy riding when the car is light and still have sufficient capacity for a heavy passenger load.

In order to accomplish the desired end as to riding qualities, the closest co-operation must exist between the railroad company and the spring manufacturer, and both sides must

Interior appearance is pleasing and the ride is quiet and comfortable

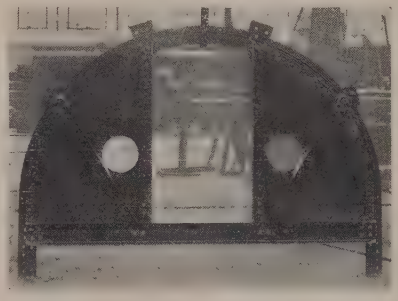


Steel body construction with special steel framing, giving great strength to vestibules

be willing to make concessions and to provide proper data and exact conditions under which the springs will be expected to operate. To provide easy riding they must be flexible. But many equipment men maintain that flexible springs will take a permanent set and will not last as long as stiffer springs. The management of the North Shore, however, has insisted that springs must be provided which will produce a comfortable riding car under all conditions of passenger load. If, in meeting these conditions, it becomes necessary to replace the springs more frequently than has been customary, that is considered merely as one of the expenses incident to the kind of service which is being rendered the public, just the same as any other operating expense.

As a matter of further convenience to the traveling public, the North Shore Line is now operating five dining cars between Chicago and Milwaukee. In addition, among the new cars which are now under construction there are one dining car and two parlor observation cars.

The five dining cars which are at present in service are arranged so that they can be converted into parlor cars by the removal of the tables, which are than stored in a locker provided for that purpose. They are operated as dining cars part of the time and as parlor cars on other trips. The new dining car which is being constructed will be used only as a dining car, so that its equipment will be adapted for dining car purposes only. Similarly the two new observation parlor cars will be designed for use as parlor cars only and no facilities will be provided for the serving of meals or luncheons.



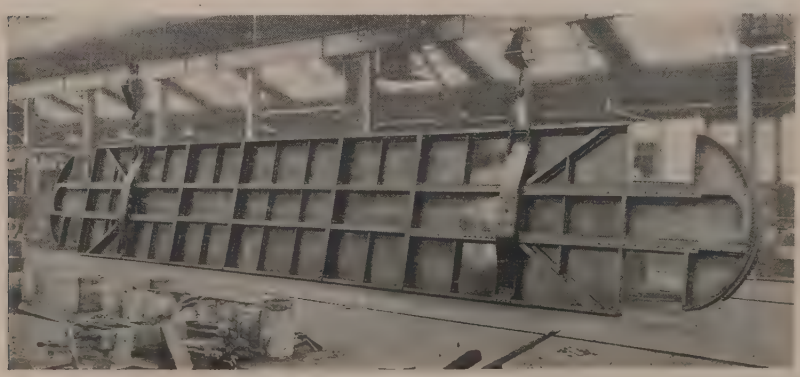
Top plate number of vestibule framing

The interior finish of all the North Shore passenger cars is a plain, simple design, but it is pleasing and the decorating is in good taste. Plush seats of steam railroad design are installed in the main passenger compartment and spaced far enough apart so that passengers are not uncomfortably crowded. The seats in the smoking compartment are upholstered in imitation leather.

The cars are well heated and ventilated and the lighting system provides generous illumination. The cars which are at present in service are equipped with large hot water heaters. While this form of heat is good in cold weather, there are times of mild weather in spring and fall when the cars are overheated, causing some discomfort to passengers. This is due to the fact that trainmen are unable to control the heaters properly. It is expected that this condition will be obviated in the new cars now under construction by the installation of an auxiliary system of electric heaters. The electric heat can be used in mild weather in spring and fall and can be easily controlled to meet the wishes of the passengers. In extremely cold weather the electric heaters can be used to supplement the hot water heaters. This scheme will give a considerable variation in the amount of heat available, and should enable trainmen to maintain a satisfactory temperature.

A feature of the new North Shore coaches will be their equipment with electric fans in addition to a first-class ventilating system.

That the policy of the management to provide fast, safe, reliable and comfortable service has been carried out in the design and construction of these cars is perhaps indicated by the growth of the passenger business handled and by the numerous letters received from patrons commenting upon the comfort of the cars and pleasure of the ride.



Steel underframe of North Shore passenger cars

Supervisory Control on the North Shore Automatic Substations

A SYSTEM of supervisory control is now being installed in two automatic substations of the Chicago, North Shore & Milwaukee Railroad. By this system the load dispatcher in North Chicago can take either or both of these stations off the line or put them back so that they will operate in the normal automatic way. The control, which uses standard equipment, is an adaptation of the Western Electric Company's train-dispatching system. No additional circuits to the substations were strung, but the control is operated through the existing single pair of telephone wires.

It is expected that the supervisory control of these two stations will be installed and in operating condition by the time of the American Electric Railway Association convention. The installation is being made by the General Electric Company, which supplied all the automatic equipment on the North Shore line.

How the Difficulties of

Using Direct Suspension Trolley in High-Speed Train Service

Have Been Worked Out on the Chicago-Milwaukee Railroad—The Bonding Experience and Manner in Which the Power Supply Is Being Improved Are Also Treated

By CLIFFORD HUTTLESTON
Electrical Engineer
Chicago, North Shore & Milwaukee Railroad

Plain span overhead on North Shore Line and, incidentally, a good view of a well-trimmed roadbed

CHANGING from a rather infrequent service employing single 30-ton wooden cars operating at a schedule speed of 15 m.p.h. to a frequent service using from one to six steel 50-ton cars per train operated at an average schedule speed of 47 m.p.h. and a maximum of 70 m.p.h., without any material changes in the overhead construction, is what has actually taken place on the property known as the Chicago, North Shore & Milwaukee Railroad. The overhead construction is what is known as "direct suspension," familiar to all, with double pole line and ⅜-in. messenger cross-spans. And today with the increase in weight of cars, more frequent service and longer trains, there are fewer delays, fewer accidents, fewer dewirements and fewer wire breaks than at any time for years past. The reason for this is due primarily to the excellent co-operation existing between the electrical, mechanical and maintenance of way departments, as laxity on the part of any one of these would contribute to poor operation. We are constantly endeavoring to live up to our slogan, "The Road of Service."

The line force of the North Shore Line consists of a foreman, ten linemen and three helpers. The equipment at the disposal of these men consists of two line cars used the year around, and an additional car used several months during the summer or heaviest traffic season. The territory covered by these men extends from Evanston, Ill., to Milwaukee, comprising 70.53 miles of double track, a branch line from Lake Bluff to Area, which has 8.6 miles of single track, and several miles of city trackage in Waukegan and Milwaukee, or a total of about 180 miles of single No. 000 grooved trolley wire, not counting sidings and crossovers. A three-phase transmission line, the d.c. feeders and two telephone lines covering the entire distance and a third telephone line 12 miles in length are also maintained by this line force. In addition to the maintenance of the overhead lines these men do all of the reconstruction and such new construction as is required on a healthy property for the improvement of service and the proper handling of new business.

Because of the difficulty of locating an overhead frog or switch so that several different types of equip-

How splice ears wear away at the ends forming shoulder and causing dewirement

ment will ride through it, and also in order to provide a smoother wire, frogs or switches are not used on the main line at crossovers or sidings. A crossover wire is provided at each track crossover, but the wires that lead to the sidings are extended, paralleling the main line to a point 300 ft. beyond the switch point to give time to change all current collectors on a train from the main-line wire to the crossover or siding wire or vice versa.

In the latter part of 1915, when the first fifteen high-speed steel cars were put into service, we undertook to operate them with trolley wheels, as the sliding contactor or shoe was to our mind then an untried piece of apparatus. In fact, it came out at about this time. Wheel operation was not at all satisfactory. It was expected that the substantial construction, pleasing appearance and comfortable riding qualities of the new cars, as well as the faster service, would please our old patrons and make new friends. Instead there were numerous dewirements and the cars were filled with a loud rumbling noise, spoiling what would otherwise be an enjoyable ride and creating anything but a favorable impression of the "improved service." It was a serious matter requiring serious consideration, and we could not afford to pass up any suggestion offered for overcoming the difficulty. Much time was spent and study made in a short period of ways and means of eliminating the noise. The retriever question was a live one. Retrieving, however, was not the cure. The sliding contactor or shoe was considered and tried and in a short time all of these cars in limited service were equipped with the Miller shoe.

We believe these sliding contact shoes have been very much improved since that time. No actual measurements of wire are taken, but the condition found on inspection shows conclusively that there is less wear on the trolley wire due to the use of sliding contacts than there is due to wheels.

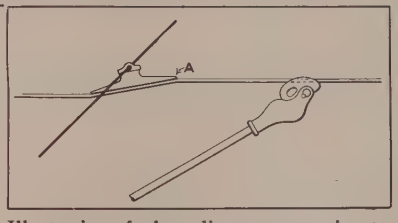
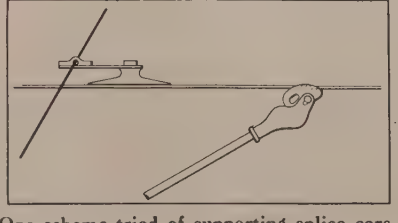


Illustration of why splice ears wear irregularly and cause dewirements

The sliding contactors put a high gloss or polish on the wire very similar to the polish on a good commutator. No lubrication is used. With the pole in the operating position, 35 lb. was found to be the best trolley pole tension. In fact, to vary much from this invites trouble and causes dewirements. Consequently, the trolley base tension is set and frequently checked with a scale or weight to keep it at this amount.

We found that six conditions, singly or in combinations of two or more, would give trouble (cause dewirements and wire breaks) with high-speed operation on direct suspension, namely:

Poor alignment. This is sometimes caused with certain soil conditions by the temporary removal of the back guys for ditching or other improvements. Alignment is easily maintained but requires watching.



One scheme tried of supporting splice ears

Slack wire. This depends much upon the temperature, but it nevertheless must not be allowed to become bad as with a high wind it causes dewirements, the rear trolley pole of a train being by far the greatest offender due to the side swing of the wire and the influence of the preceding trolleys on it. And without a high wind, the resulting rapid change in level or height of the shoe above the rail will frequently cause dewirements, or cause the operation of a sensitive retriever. For successful operation slack wire must be cut out, and when cold weather sets in some slack must be put back or breaks under tension will result.

Improper trolley base tension, referred to above.

Stiff trolley base or one not working smoothly because of pitting in raceway or for other reasons. In one instance when we were unable to account for an epidemic of dewirements, a list of the offending cars was obtained and the trouble was detected and cured by replacing the inferior bases.

Rough track. This causes rocking or side sway of the car and it may cause dewirement if there is slack wire or a stiff trolley base. We are rather proud of our present roadbed and track, and extensive improvements are constantly being made which are mitigating this source of trolley trouble.

Wire splices. We are not satisfied with the present-day practice of splicing trolley wires. We have tried different types of splicing ears with their "smooth underrun" but to date have not found one that gives us entirely satisfactory service under high-speed operation with a sliding current collector. We have very few wire breaks, but most of those we do have are caused by the unsatisfactory splices. As the sliding current collector approaches a splice, particularly when located at the span wire, the near end of the splice tends to rise as shown exaggerated in an accompanying sketch. The slider tends to dig in to the splice at point *A* and bounds away, making contact again after passing the splice. In time, a shoulder is formed on the underside and if let go this will cause a dewirement, or the continual pounding will cause the wire to become crystallized and it then eventually

Special Drew ear designed to overcome rapid wear of ordinary splice ear

breaks just inside the splice, it being impossible to detect crystallization on inspection. We are trying one or two splices installed as shown in another sketch reproduced herewith. We find these give longer service but they are not the solution of the problem. At our request a special splice was designed by the Drew Electric & Manufacturing Company which appears as shown in an accompanying picture. This is a long sherardized malleable casting in which the two ends of the trolley are brought together without bending. While it has given reasonably good service we are not entirely satisfied. We hope, however, that this splice can be improved upon as it provides an absolutely smooth underrun and has none of the objections belonging to the common splicer. We have given it about one year's trial and believe that it is going to enable us to cut down materially on the maintenance of splices. Until it is improved so we can install it generally, we shall have to continue to true up frequently the ordinary splices and renew them before they become bad.

Most of our splices are installed with boss at the cross span. Splices without boss installed away from the cross-span give much smoother operation and longer life if they do not become tipped to one side. If slightly tipped, or if a shoe becomes deeply grooved, as happened occasionally during the earlier days of shoe operation, we again have trouble. Over the entire system we have been averaging about eight years wearing life on the trolley wire and about eighteen months on the splices. This life should be considered in conjunction with the annual car mileage on the system presented in the article by Mr. Thompson, elsewhere in this issue.

For some years on wire renewals we have been recovering 60 per cent of the original weight as scrap, 40 per cent being the usual wear. Considering the scrap value of the trolley wire and the comparatively low labor cost on a renewal job, we favor renewing before 40 per cent weight has been used in wear. Probably from 30 per cent to 35 per cent wear will be found about right in our case, to insure a good factor of safety against breaks.

Some Bonding Experience

The concealed 10-in. No. 0000 compressed terminal rail bond was our standard for some years. Six or eight men installed thirty or thirty-five bonds per day on pick-up work where renewals ran about 6 per cent. The American Steel & Wire Company bond tester was used in locating bad joints. When the resistance of a joint was found to equal that of 6 ft. or more of rail, the joint was marked by the testers as being bad.

As the service increased the question of opening joints under service conditions and the slowing down and stopping of trains became a more and more serious objection. In 1919, during January, No. 0000 L.U. bonds applied with the Rail Welding & Bonding Company machine were adopted as standard. A foreman and three men install from sixty to eighty of these bonds per day on pick-up work. L.U. bonds of 300,000 circ.mil capacity were installed during 1920. But during 1921, when rail renewals were made with 100-lb. steel, it was decided to increase the capacity of bonds to 400,000 circ.mil.

The laying of 100-lb. steel using heavy joint plates necessitated the development of a Webber type bond of 400,000-circ-mil capacity which could be applied with the bonding machine. For the purpose of comparing results, 38-in., 400,000-circ.-mil cable bonds are also being installed. These are passed through the space between the plate and the web of the rail and the terminals welded to the head of the rail. For the same reason a few 400,000-circ.-mil steel terminal Webber type bonds are to be installed, using a metal electrode in welding.

The four rails are cross-bonded every 500 ft., the cross-bonds being stapled to the ties and covered up in order to discourage theft. About 40,000 bonds have been applied during the past three years.

Crossing signs and center wig-wag installation

Another type of auto-flag warning more generally used on this line

Typical automatic substation on North Shore Line

We have forty-eight highway crossings protected by gates, thirty-five by auto-flag or wigwag signals and twelve by bell signals. The signals are operated on 600-volt current, using rail contactors for control. The total maintenance cost on the auto-flags and bells is approximately $10,000 per year.

Power Improvements of Great Importance

When the reorganization of the company took place in 1916, a careful study was made of the power conditions on the property, having in mind needed improvements and a construction program to take care of future demands. At this time seven manually operated substations were in operation on the main line, spaced approximately 13 miles apart, and one at Libertyville on the Libertyville Branch.

It was estimated that if sufficient copper was to be added to give satisfactory voltage conditions, it would be necessary to install approximately 177 miles of 500,000-circ.mil cable at an approximate cost of $650,000. Changing the trolley voltage would necessitate the scrapping of many old type, 600-volt motors which were in use, and it was thought inadvisable to carry 1,200 volts on the trolley going through the numerous towns.

After having considered the problem from its various angles, it was decided that automatic substations should be placed midway between the manually operated stations. Designs and plans were adopted only after a study had been made of the automatically operated stations in use on other properties.

Two 500-kw. stations were put in service during 1917, one during 1918 and one during 1921. One of the two 300-kw. machines at Libertyville was equipped for automatic operation during 1920 and the first 500-kw. installation was changed this year to a 1,000-kw. station. Today we have one 300-kw., three 500-kw. and three 1,000-kw. stations automatically operated. Two (1,000 kw. each) are 60 cycle and the others 25. Six are of the inclosed type and one semi-inclosed.

The buildings are of fireproof construction, roomy enough to permit of the installation of machines of greater capacity and, in general, the arrangement is such that extension can be made and additional or duplicate equipment installed to harmonize with the arrangement of the present equipment.

These seven stations, spread over a territory covering 60.5 miles as seen on the map in a previous general article on the North Shore Line, are inspected daily and given general care by a force consisting of three men as compared to the twenty-one operators required for the seven manually operated stations. The operation is checked by means of recording charts and mechanical counters installed on different parts of the equipment. While we look for improvements, the present automatic equipments have our unqualified indorsement, for aside from the savings accomplished in labor, distribution losses, copper and idle running time, the machines are not subjected to the abuses which sometimes obtain in manually operated stations. It is estimated that the efficiency of distribution has been increased from 20 to 25 per cent. On account of the rapidly changing service conditions it is difficult to make accurate comparisons, but a self-evident fact is that without these additions to converter capacity we could not operate our present service.

38-in. welded cable bonds on 100-lb. rail

Webber type bond developed for welding on 100-lb. rail

Building Track and Right-of-Way to Create Traffic

By J. S. HYATT
Engineer Maintenance of Way
Chicago, North Shore & Milwaukee Railroad

How the Chicago, North Shore & Milwaukee Railroad Has Within a Short Time Reconstructed the Track to Make a High-Grade, Smooth-Riding Roadbed — The Elements of Contented Track Employees, Clean and Safe Right-of-Way and Attractive Station Facilities as Important Traffic Producers Are Treated—A Practical Article for Way Engineers

Standard unit type framed road crossing as built on North Shore Line

ROAD MEN are not generally looked upon as aids to the traffic department or as advertising agents, but we believe a very important and valuable element of their worth is lost when this viewpoint is overlooked.

A safe, easy-riding and good appearing track is fundamental in obtaining and retaining traffic. The most effective selling organization that can be produced in a railroad will be ineffective, if the track and its maintenance are not what they should be. The road men are therefore a most important factor in producing traffic. With the ever-present pressure for economy it is vital that the small groups of workers who are handicapped by the scattered locations of their work and the interruptions of weather be efficiently organized and supervised, if the best results are to be obtained. When the necessity for reducing operating expenses comes on a railroad the first place in which it seems easiest to reduce expenses is the road work, This means the neglect of the very foundation upon which rest all the efforts of the railroad to carry on its business.

We believe the history of the North Shore Line very forcibly illustrates this fact. Built (in its main essentials) as a first-class interurban railroad capable of carrying high-speed service, under the policies of the eight or nine years of the receivership the advertising features of smooth roadbed, clean, well-kept right-of-way, clean and convenient station facilities and satisfied and enthusiastic employees were so overlooked that the traveling public was beginning to fear the neglect of the essential maintenance duties which insure safety.

The improvements on the North Shore Line that have so aided in the increase of its revenues commenced with the elimination of all wooden trestles and temporary bridges and the purchase of steel rolling stock. Coincident with the elimination of these bridges, and in fact as a part of this improvement, the narrow stretches of roadbed on high fills approaching these bridges were widened. The first steps taken in improving the drainage conditions were in the deep and long cuts, done by widening these cuts and by digging deep and ample ditches with an "American" ditcher. We also proceeded at once upon a plan of producing a safe, smooth-riding track that would carry the high-speed steel cars of the North Shore Line without fatigue or anxiety to patrons. The essential elements of such a structure are known to all. Our plan was simply one that would be used by any intelligent engineer.

The ties were immediately brought to a high state of maintenance by a liberal policy of renewal and, thanks to the faith and foresight of the management, we were able to requisition and obtain ties of the best type and durability, ties of no lower grade than a No. 3 white oak being used, and many of our ties were red oak, creosote-treated, until the conditions of war times made it impracticable for us to get good creosote oil for treatment.

Much of the rail was of very light weight and badly worn through long use under light maintenance, and a

plan was immediately put in effect of renewing all of this light rail with 80-lb. and 100-lb. rail. Such of the old rail that was heavy enough and in suitable condition for rehabilitation was supplied with new angle bars, rebolted, properly spaced and anchored.

Following immediately upon these preliminaries, an extensive plan of reballasting was inaugurated. The road was originally ballasted with 24 in. of gravel ballast but this ballast, a large part of which was of the cementing type, had been allowed to become so fouled with weeds that its drainage qualities were greatly impaired, and so it was immediately recognized that it would be necessary to lift the track out of this ballast and overlay it with a more substantial and porous type of ballast. Due to the immediate necessity to get the road in good riding condition and because of the high cost of the better types of ballast such as slag and stone and the difficulites of obtaining them, and also with the idea in mind of using a method that would more effectively kill the weeds and leave the sub-ballast in a contour that would improve drainage, the easily obtained cinder output of a steel mill on our line was contracted for. The old ballast was first put under the ties and the track resurfaced on cinders, widening out the ballast bed with these cinders to form a liberal shoulder to receive the later application of stone or slag ballast. We have found this method admirably adapted to the treatment of cementing gravel and very economical in the amount of stone later required. We found that the clay in the cementing gravel would work up through a very thick layer of stone ballast. But where the track was treated with the light cinder lift, the drainage and the supporting character of the sub-ballast were so improved that a lighter layer of stone ballast was quite as effective. This plan also enabled us to get over a great many more miles of track immediately and put it in good riding condition, though of course the final expense will be somewhat greater than the direct application of stone ballast.

In all of our track design, drainage has had to receive first consideration, as the soil throughout the whole line is one that is quite impervious to water, and in some sections is of such a character as to give us a great deal of trouble when not properly drained, particularly at the north end of the line where a great many of the cuts are very deep and long. These vary in length from ½ to 1½ miles, and in depth from 20 to 30 ft. Even the wide and deep ditches constructed with our American ditcher did not seem to meet the situation here, and all of these cuts have been subdrained by a double row of tile laid in a trench 3 to 4 ft. deep and backfilled with cinders.

Making Things Attractive for Trackmen

Our full program of improvement was begun just about the time that the world war was commanding the majority of our labor and when it was most difficult to obtain adequate help. We were forced rather by necessity than by choice to establish an entirely new system of caring for our men, but the results have proved so advantageous that it is certain we will never go back to the old-time methods.

In place of the box car with its contract commissary and all the privations, inconveniences and irritations attendant upon it for the men, we established at convenient locations permanent camps where our men could be adequately housed with ample space per man, protected by proper means from flies and vermin, furnished with clean bedding and bath. We established our own commissary, fed the men ourselves, not for profit but for satisfaction, and devised a method of furnishing a hot lunch on the job at noonday, thus eliminating the one drawback of the permanent camp. The installation of such a camp seemed at first an extravagance; and we doubt, if it had not been for the necessities of the times, whether we would have had the courage to go ahead as we did, but the returns that we have received in lower turnover, better class of employees, and more work out of satisfied employees, has proved the wisdom of the expenditure.

As a natural sequence of this experience and as a result of some of the lessons taught by the war and a desire to develop foremen from our force, to replenish the decreasing number of trackmen available for these positions, we employed a Y. M. C. A. man and established an Americanization and Foremen's School among our trackmen. While these schools were primarily designed to perfect safety by teaching the English language and to train men for foremen's positions by showing them the right way to do work and the reason for it, they have had a very great value in getting the men and the supervisory force together, in changing the ideals of the foreign element in our track gangs and increasing the general interest in the work among all the track employees.

These schools were started at convenient locations along the right-of-way, taking up first Roberts' Lessons in English at an evening session held for each class twice a week. These lessons were supplemented with a study of the Constitution of the United States and the fundamentals of our government, so that any of our men were able, as soon as they wished, to take out their citizenship papers. They were then further extended into simple instruction in grammar and arithmetic and matter having particular reference to the daily work.

The foremen's school was an outgrowth of the Americanization school for the benefit of the more intelligent men and the foremen, at which they took up the various problems connected with the maintenance of way, such as drainage, installation of ties, care of right-of-way, keeping of records and reports, duties of foremen to their men, and kindred subjects regarding which the foremen should be well informed. These classes have been supplemented with music and songs and motion pictures to give them life and interest. Educational films of the universities were very largely drawn upon, instructing the men in safety work, sanitation and prevention of disease. The foremen's classes were largely illustrated by lantern slides of actual examples of good and bad work on their own and adjacent sections of the North Shore Line.

Both in these foremen's classes and in the execution of our daily work, we have tried to emphasize two features of the maintenance of way work, namely, systematic work programs and systematic clean-ups.

Keeping the Right-of-Way Dressed Up

Killing weeds and keeping the right-of-way in neat condition is a matter that gives all a great deal of concern, some not so much as it should, for there is nothing that will impress the traveling public more favorably than a clean right-of-way. A weedy one always leads one to feel that the property is poorly maintained. This work involves a

very large expenditure, and if it is done by the usual hoe and shovel method it takes the labor from the track maintenance at the time when it is most needed. We have obviated this drain very largely by the use of chemical weed killer. After going through the usual experimental stage, we have come to the conclusion that the proper method of treating is to have our own treatment cars and our own storage tanks, thus enabling us to make more frequent applications and make them at the proper time. A caustic arsenic solution is used. The cost per mile of weeding by this method has been reduced to approximately 25 per cent of the hand method. This is partly accounted for by the policy followed of frequent light treatments rather than fewer heavy applications.

Station Facilities Made Pleasing

In considering the advertising features of the maintenance of way, the question of station facilities, crossing protection, or the construction of highway crossings have not been overlooked, as at these points the railroad makes its first impression on the public. During the last few years the North Shore Line has greatly improved its station facilities. Terminal stations have been built both in Chicago and Milwaukee that have enabled the road to give much improved service to its through patrons. But its improvements have not been limited to these expensive terminal facilities, as many minor improvements have been made to all stations along the line.

Cleanliness has been greatly stressed, and although a station has but little traffic and is very small, the utmost has been done to keep it in a clean and satisfactory condition for our patrons. To this end has been inaugurated a thorough system of janitor service under ample supervision. Stoves have been installed even in the way stations where no agents are in attendance and a liberal application of paint has kept the appearance of the stations in a cheerful and well-maintained condition.

The safety of the patrons has been constantly thought of in planning and improving these stations. This frequently has involved the moving of stations from one side of the road to the other, or of moving them back from the tracks. Stations sufficiently important to justify an agent have been largely rebuilt, providing ample office room, proper toilet facilities and in many cases the installation of concessions operated by the railroad company. Regular sanitary inspection has tended to keep all employees responsible for the maintenance of these stations on the job, thus insuring station facilities that the patrons are pleased to use.

With the inauguration of the merchandise dispatch service, many additional facilities were required, and these stations, team tracks and teamways have all been constructed, not with the idea of building them as cheaply as possible, but with the idea of building a structure that will serve and attract the shippers.

In improving our highway crossings, considerable thought is given to the amount of highway traffic that they will have to carry. It is our policy to make these crossings a little wider than the adjacent highway is likely to be. In order to get the maximum life from these crossings, we have adopted the standard policy of not having any joints in the crossing, and when a new crossing is placed, all ties under it are renewed. We construct these crossings of 4 ft. x 6 in. treated maple heart plank, frame them and cover the wearing surface with a coat of tarvia and sand. We find that the riding qualities and length of life are greatly improved by this treatment. For less traveled crossings we find that the Headley crossing makes a very good substitute for the plank, and is much less costly. This crossing is made of crushed stone treated in a concrete mixer with Headley's "Good Road Oil." This is a patented asphalt emulsion which solidifies upon drying out, thus rendering the whole mass a monolith in a few days.

Safety at Grade Crossings

The safety of the employees and the public has not been overlooked by the maintenance of way department. Fully 75 per cent of our crossings have been protected in the last four years. This means every crossing between Evanston and Waukegan, and all of the more important ones in the more sparsely settled district between Waukegan and Milwaukee. Practically all of these gates are of the wire-pull type, designed by our own engineers and built from our own patterns in nearby foundries and assembled in our own shops. In a few instances where gates could be controlled by interlocking towermen without additional expense, the electric gate has been installed on account of the ease of its control from a distant point.

The right-of-way has been thoroughly marked by crossing signs and station boards and by permanent slow-speed boards at all points where the physical condition constantly requires reduced speed. These boards are placed at the motorman's right, usually 1,000 ft. back from the point of reduced speed, and the maximum speed allowed is noted so that even a motorman not familiar with the road will have little difficulty in properly taking a train over the North Shore Line.

Each section gang is provided with slow boards and slow lights and all other signals, and by frequent drills and safety meetings these men are kept familiar with the proper methods of protecting themselves while at work and of advising train crews of sections that need caution in traversing. A systematic patrol is kept over the whole road so that any defect in track structure is detected early.

Since the reorganization of the company, the expired franchises in Waukegan, Lake Forest and Highland Park have all been renewed. In the first city, all the track in city pavement has been reconstructed, our franchise requiring brick pavement. Our standard type of construction has been 91-lb. rail on International or Dayton ties, with thermit rail joints laid on 6 in. of concrete foundation. We have felt it advisable to subdrain all this track structure, and this has been done by a longitudinal line of pipe which in double track is supplemented with branch lines in herringbone formation. By this method we have very successfully prevented track that has previously given us much trouble from settling out of surface.

In Lake Forest and Highland Park, where the right-of-way was almost entirely on the street previous to the granting of the new franchise, under the terms of these franchises the right-of-way has been obtained and the streets moved so as to give the railroad a private right-of-way 80 to 100 ft. in width, and the city a street with unobstructed pavement.

These improvements have all materially aided the elimination of slow speed points and largely made possible the inauguration of the two hour and ten minute service between Chicago and Milwaukee by the Interstate, Badger and Eastern Limiteds, and have done much to justify the slogan, "The Road of Service."

Moving Cars by Telephone

Practically All Operating Matters as Well as Other Business Clears Through a Central Switchboard in Main Office of Chicago Surface Lines — Operators Act as Division Superintendent in Emergency

THE Chicago Surface Lines has a very thorough and practical system for dispatching aid or instructions to any location where a blockade or breakdown has occurred, or for doing the proper thing immediately in any emergency. The focus of this system is a telephone switchboard located in the office of the superintendent of transportation in the Borland Building, where the downtown main offices of the railway are located. Each operator is more than a person who merely connects one circuit with another. Each one has a clear mental picture of the whole railway system and knows immediately the nearest wreck wagon to any trouble or delay that arises. In case of traffic tie-up, the operator temporarily exercises the judgment of a division superintendent by advising how to get around the trouble. In the case of more serious trouble or accident, the situation is turned over to the general superintendent.

The switchboard consists of two positions, and from 8 a.m. to 5:30 p.m. two operators are normally on duty. Into this board come the circuits from the twelve division headquarters, in each of which is located a small private branch exchange board that connects with the box telephones located all over the system. The board is also provided with eleven incoming and seven outgoing trunks to the city telephone system. Lines are also provided to other parts of the system such as the west and south side shops, the engineering office on the north side, the claim and legal department on the west side, the various operating officials and executives of the road in the Borland Building, and the three headquarters of the line repair trucks, and to numerous other points of activity on the system. All the substation telephones on the city system must be reached through trunks to the city exchanges.

In any trouble or emergency the procedure is for the conductor to go to the nearest telephone in a store and call Randolph 0581. The operator immediately calls the nearest trouble wagon, which proceeds to the scene of the delay and in the meantime the nearest car station is called to send a supervisor or inspector. If the wrecking crew finds that the trouble is too serious for it to handle in short order, a call is put in immediately for help. The operator then dispatches the proper piece of equipment to the location.

As soon as the cause of any trouble or delay has been removed, the wrecking crew calls the switchboard, giving the time that the track was cleared and the number of the car or cars that were delayed. The operator keeps a record of all delays, which shows the location, time, nature and time consumed by the depot from which the wreck wagon was sent. On this same form are also recorded the facts about any other dispatching that is done, such as the line repair wagon or the ambulance in case of an accident.

In the switchboard room is a fire alarm ticker which gives notice of all alarms that are turned in. After the operator has read the number on the tape, he calls the depot in whose territory the fire is, and a supervisor is immediately sent out. If the supervisor finds that hose bridges are necessary to keep the cars running, he immediately calls back and the operator dispatches the necessary equipment.

The operator, besides having a clear mental picture of the system, is also familiar with the police precinct districts, the location of hospitals, etc. In the case of accident, it is the operator at the central switchboard who gets the claim department on the job, and if necessary sends an ambulance from the nearest police station. When a heavy rainstorm floods the subways under the railroad viaducts, it is the operator who notifies the track department. It would be almost impossible to list or classify the multitude of emergencies, both large and small, that are handled through this central switchboard. The operators have an intimate "speaking" acquaintance with all the personnel of the system and always know where any man can be found. Besides taking care of the work in connection with keeping the system operating, they also answer many calls from people who wish to know where to apply for lost articles, from those who want to know how to get from one place to another on the surface lines and from others asking for miscellaneous information or who have business with any company official. This one switchboard is the central clearing house for nearly all matters of or pertaining to company affairs.

Chicago Tunnel Handles Excavated Material

THE Chicago Tunnel Company, which owns and operates 62 miles of underground tunnel lying under the central portion of Chicago, has been removing a great deal of excavated material from building sites with its tunnel trains during the last few years. This unusual method has relieved the streets of much truck haulage and furnished a cheap and handy way for disposal of the excavated material.

In deep foundation work and in excavations for basements and subbasements of large buildings, it is a common practice to sink an inclined shaft or chute to the tunnel under the site, the tunnel being enlarged or having a spur for a siding to enable a car to be set under the chute.

The tunnel system is an electrically operated freight railway of 2-ft. gage. The tunnel is of oval section about 7½ ft. high and 6 ft. wide with the rail level approximately 45 ft. below the surface. It was built particularly for freight-handling service and connects numerous freight railway stations with commercial houses, department stores, warehouses and office buildings.

The tunnel traffic averages about 10,000 cu.yd. of excavated material monthly, 7,500 cu.yd. of ashes from buildings and power plants, 4,000 cu.yd. of coal to these plants, and 45,000 tons of merchandise handled to and from railway freight houses. The coal business was formerly much larger, but of late the larger coal companies have maintained fleets of motor trucks for the delivery of their own coal. The tunnel cars are of 3½ cu.yd. capacity and are used for hauling the excavated material, refuse and ashes. Trains of from six to eight cars of such material and twelve to fifteen cars of freight are handled at an average speed of 8 m.p.h. by electric locomotives, of which 110 are now in daily service. The average haul to the disposal station is 2½ miles.

The Severity of Chicago's Traffic Problem

and Observations on Measures of Relief in Use or Applicable Generally in Large Cities

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OF THE MANY perplexing problems which add to the difficulties confronting operating officials of street railways in our large cities, the regulation of vehicular and pedestrian traffic is of growing importance. Business districts are daily congested, the movement of cars is impeded and operating costs rise while service declines as the speed of cars is diminished.

The street widths, which were satisfactory in earlier years, are no longer adequate for the ever-growing volume of traffic. Henry Ford a short time ago made a statement that should demand a more thorough study of our traffic problems. He estimated the automobile saturation point for the United States at 30,000,000 motor cars—nearly three times the number of cars now in use. If traffic conditions render the operation of street cars difficult today what can be expected when Mr. Ford's saturation point is reached?

In large cities the cost of delay in handling traffic is an enormous charge against all kinds of business, and in Chicago this loss probably runs over $25,000,000 per year. The present space between curbs has been reduced one-third or one-half of its useful width, by devoting valuable street space to parking.

The first step to minimize obstruction due to unlimited parking has usually been to permit parking for one hour, and the second step has usually been to reduce the time period to thirty minutes or to fifteen minutes. While these changes and regulations are intended to facilitate traffic movement, it appears that the contrary result has been achieved. In order to conform with time limits drivers either move a short distance or jockey for place at the curb and consequently burden the streets with useless mileage and also obstruct the movement of through traffic.

In large cities the parking space is usually occupied almost completely.

State and Madison Streets, Chicago, between 12 and 1 p.m.

Limited Period Parking Tends to Increase Congestion—Complete Prohibition Has Drawbacks, But Is the Best System—Pedestrian Movements Are Better Uncontrolled

The delays and obstructions to traffic which arise from the pulling in and out of parking spaces are considerable, and these are rarely given adequate consideration in determining the authorized period for parking. The importance of this factor is shown if we consider, comparatively, parking periods of various lengths on a twelve-hour basis. A period of one hour permits twelve changes; of thirty minutes, twenty-four changes; fifteen minutes, forty-eight changes for each vehicle. And it must be remembered that in each change there are two moves—out and in.

The complete prohibition of parking during the rush hours, while necessary and desirable, causes a considerable amount of "cruising" on the part of private cars, which adds to the congestion and at the same time increases the number of right and left-hand turns. However, this restriction should be enforced as its benefits are far greater than the objectionable cruising.

The complete all day prohibition of parking in the central business district in any city, while ideal from a traffic point of view, works a hardship on certain classes of business and inconvenience to motorists unless adequate and convenient parking spaces are provided.

The prohibition of parking on some of the streets in the business district is criticised as it results in discrimination as between merchants located on non-parking streets and others located in the same general area where parking is permitted.

Parking for an unlimited time results in the exclusion of all persons desiring to do business who arrive after the parking spaces are filled.

The south end of Dearborn Street Bridge, Chicago, looks like this at 9 a.m.

In Chicago the available parking space at the curb in the Loop district will provide for the standing of 3,700 cars. As there are nearly 250,000 cars in the Chicago territory, the validity of this criticism is at once apparent.

Traffic regulations have grown rapidly and their present forms are many and varied—frequently mystifying to drivers—and their complexity often adds to rather than reduces confusion. Multiplicity of ordinances does not add to the effectiveness of regulation, but rather emphasizes the lack of proper education of drivers.

Because of such abundance of rules, the courts become clogged and general disregard for traffic rules increases. Consequently we must do more in the way of educating the public to observe at all times the ordinary rules of the road and to develop a natural road courtesy which will bring about improvement in traffic movement and increase the comfort and safety of all. Many out of hand suggestions are made to improve conditions at a bad point which usually result in producing new points of congestion, for reasons shown in tables that follow, giving the variation in traffic density at different locations on the same street.

Few people have any idea of the volume of traffic in our dense centers of activity. Here in Chicago there are points where on normal days 2,000 vehicles pass through a street intersection in an hour, and in the same period at the same place 26,000 to 30,000 pedestrians cross the intersecting streets from curb to curb—more than eight persons per second.

VARIATION OF VEHICULAR TRAFFIC ON A NORMAL WEEK-DAY AT DIFFERENT INTERSECTIONS OF THE SAME THOROUGHFARE

On State Street 4 p.m. to 5 p.m.	North and South	East and West	Tota
At Lake	670	615	1,285
At Randolph	839	858	1,697
At Washington*	880	1,084	1,964
At Madison†	979	682	1,661
At Monroe	909	800	1,709
At Adams	993	405	1,398
At Jackson	994	1,005	1,949
At Van Buren	930	506	1,436
At Harrison	813	507	1,320

* 26,000 pedestrians in same hour.
† 30,000 pedestrians in same hour.

Note:—At Washington Street the east and west traffic is 55 per cent of the total, while at Adams Street it is only 29 per cent.

On Jackson Boulevard 5 p.m. to 6 p.m.	North and South	East and West	Total
At Wabash	957	890	1,947
At State	775	839	1,614
At Dearborn	460	904	1,364
At Clark	620	1,242	1,862
At Wells	650	1,167	1,817
At Franklin	502	1,499	2,001

Note:—At Franklin Street the east and west traffic is 75 per cent, while at Wabash Avenue it is 46 per cent.

On Washington Street 4 p.m. to 5 p.m.	North and South	East and West	Total
At Wabash	906	1,090	1,996
At State	880	1,084	1,964
At Dearborn	531	874	1,405
At Clark	709	967	1,676
At La Salle	740	1,074	1,814
At Wells	587	1,075	1,662
At Franklin	693	940	1,633

Accompanying graphs show respectively the hourly volume of passenger and commercial vehicle traffic flowing outbound from the Loop district, an area of about 0.49 square mile. The volume of all traffic and the passenger carrying value of the different vehicles are estimated as follows:

	Number	Passengers
Horse-drawn vehicles	14,500	14,500
Motor-driven vehicles	17,180	17,200
Total commercial vehicles	31,680	31,700
Passenger autos	42,130	84,300
	73,810	116,000
Street cars	8,360	330,000
	82,170	446,000
	Number	Passengers
Vehicles, per cent	90	26
Street cars, per cent	10	74
	100	100

On Washington and Clark Streets, Chicago, between 5 and 6 p.m.

The above percentages show conclusively that, where such conditions exist, the traction officials and the patrons of their service have an unquestionable right and interest in the traffic problem, and that all sound regulation must take into consideration all classes of the traveling public.

Signals of different types are installed with a view of controlling and speeding up traffic, and after trial

are said to be a great improvement. Usually this idea has no real foundation for the reason that no record was made of actual conditions prior to the installation. Lack of real knowledge of facts brings about honest, though mistaken, opinions. Accurate records, therefore, should be made by municipalities. Only with continued study of fairly large areas will it be possible to handle intelligently the growing traffic, minimize the delays to car riders, and prevent loss to the railway companies and to business interests.

GREATER UNIFORMITY OF SIGNS AND SIGNALS

At the present time signs of every conceivable size and description are installed to secure the same result. Caution and danger lights are many and various. It seems most obvious that simplicity and uniformity in signs and in color of lights is highly desirable and that efforts should be made to secure the adoption of a nearly universal system as to these details.

But as to general plans of traffic control, it must be realized that nearly every city has its peculiarities in street layout, in street spacing and in general topography. The volume of traffic varies on adjacent streets and there is a marked difference also in the traffic density and character in the various sections of the same street. Therefore no general rule can be broadly applied to our large cities. Because certain regulations prove very successful in one city does not warrant the conclusion that they will be helpful elsewhere.

During the recent street car strike one-way traffic was adopted for the business district and it was found that these heavy intersections carried 3,000 vehicles in an hour, indicating that the absence of street cars added 50 per cent to our street capacity.

From observations made then it appears that one-way traffic, in congested areas, increases the hazard to pedestrians and adds to the mileage of vehicles. A condition arises at street intersections where only the near-side crosswalks permit a free movement of pedestrians, the others being blocked by the turning of vehicles from lanes which occupy the full width of the street. The density of traffic at these turns delays the movement of pedestrians and consequently the near-side crosswalks are forced to carry an unusually large volume of foot traffic.

Traffic at the junction of Halsted, Milwaukee and Grand Avenue, Chicago, at 5 p.m.

It is to be regretted that we have not been able to check normal two-way traffic in the Loop district in the absence of street cars, thereby having conclusive comparative data at our disposal.

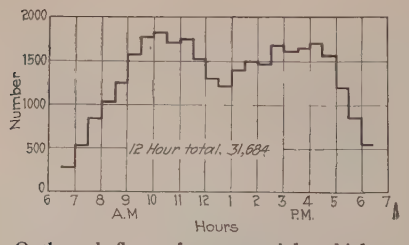
In Chicago the traffic division of the Police Department has attempted several times to control the pedestrian movement by the whistle signals which govern the vehicle movement. These experiments resulted in extreme congestion and the results were not satisfactory.

Our conclusion is that, owing to the density of pedestrian traffic, the best means of handling both classes of traffic is to permit the pedestrians to filter through the traffic without obeying the whistle signals, although there may result a slight slowing up of vehicles. This is our present practice and accidents in the Loop are nil.

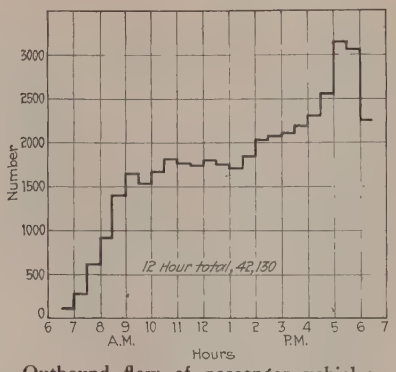
SPEED OF TRAFFIC ON MICHIGAN BOULEVARD

Michigan Boulevard has recently been improved by widening and by the installation of a double-deck bridge, separating heavy and light traffic. About $16,000,000 was spent in constructing this improvement. Today many complaints arise on account of traffic conditions on this thoroughfare, the usual complaint being based upon the low speed of automobiles. An accompanying chart shows the actual condition, giving the average speeds for the non-rush hours

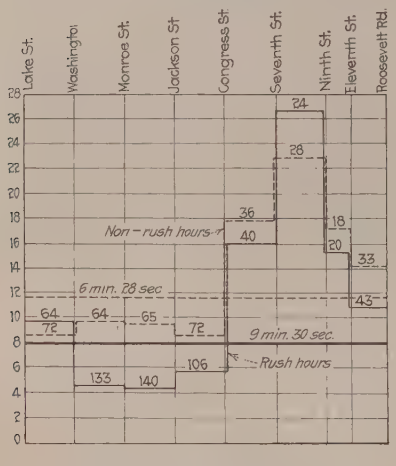
Madison Street at Wells, 8:30 a.m.



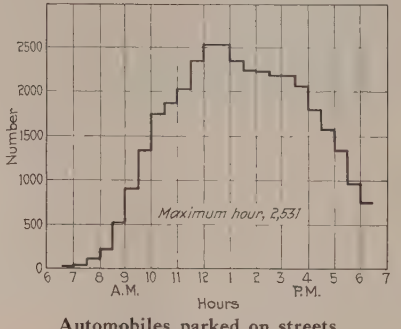
Outbound flow of commercial vehicles from Loop



Outbound flow of passenger vehicles from Loop



Average speed of automobiles along Michigan Avenue, m p.h.



Automobiles parked on streets witthin the Loop

and also for the rush hour (5 p.m. to 6 p.m.) based upon several thousand observations. While these average speeds may not be all that is to be desired, yet when the volume of traffic (nearly 5,000 cars per hour pass a given point in the rush hour) is considered, it is evident that traffic conditions are really not as bad as the casual observer believes.

Another chart reproduced herewith shows the average speed of vehicles in the rush and non-rush hours between the various street intersections on Michigan Boulevard. The extremely low speed shown between Jackson Boulevard and Lake Street is due to the ebb and flow of traffic from the Loop district into this great artery, and the situation is further complexed by the movements of cars to and from the Grant Park parking space east of the Boulevard, where upward of 2,500 motor cars are stored daily. Delays to traffic on Michigan Avenue affect the adjacent streets in the Loop, for within a comparatively few minutes, a temporary blockade on Michigan Avenue is felt on the cross streets two, three and four blocks west.

Perhaps the foregoing discussion will serve to emphasize the essential need that accurate records be made for purposes of future comparisons and that traffic be continuously studied, so that as its growth rises to meet the estimate of Mr. Ford, railway and city officials will be equipped to cope with the situation. By this means alone can efficient regulation be achieved.

The Chicago elevated railroads have 1,664 cars, and in 1920 the average cost per car for maintenance was $1,202. In 1914 the average cost for maintenance per car was $497.

Dearborn Street Bridge, Chicago, at 9 a.m.

Materials Quantities in Surface Lines Electrical System

THE following compilation showing the amount of materials which comprise the electrical distribution system of the Chicago Surface Lines is interesting because it transmits energy to a network of more than 1,000 miles of track, on more than 90 per cent of which the voltage ranges between 550 and 600 during rush-hour conditions and the remaining 10 per cent is practically all above 500 volts. This is the condition that exists when there is also a considerable electric car heating load.

Substations	Number	Number of Machines	Total Capacity, Kilowatts
Chicago Surface Lines	20	67	142,400
Commonwealth Edison Company	12	33	105,000
	32	100	247,400

Positive System.	
Weatherproof cables, all sizes	934.5 miles
Lead covered cables, all sizes	537.6 miles
Conduit	1,500.7 miles
Manholes	3,285
Negative System.	
Weatherproof cables, all sizes	57.1 miles
Straight track auxiliary cables	594.3 miles
Special trackwork cables	138.2 miles
Tap to "L" structures	2.6 miles
Overhead System.	
Trolley, all sizes	1,034 6 miles
Trough	46.7 miles
Poles—iron	41,682
Poles—wood	4,194
Poles—total	45,876
Electric switches	124

* Other than street railway load is also supplied from these substations.

The record for the number of cars entering the Loop in one hour on the Chicago Elevated Railroad was made on April 29, 1920, when 953 ran into the Loop in sixty minutes.

Arkansas Utilities Association

ON ACCOUNT of conflicting dates with other conventions, the executive committee of the Arkansas Utilities Association has changed the convention dates of the association from Oct. 9-10, 1922, to Nov. 7-9, 1922.

The convention will have headquarters at the Arlington Hotel, Hot Springs, National Park, Ark.

Investment Bankers' Association of America

THE eleventh annual convention of the Investment Bankers' Association of America is to be held at the Del Monte Hotel, Del Monte, Calif., Oct. 9-12. There will be reports from committees on the following subjects: Finance, membership, railroad securities, education, marine securities, municipal securities, public service securities, real estate securities, fraudulent advertising, publicity, irrigation securities, foreign securities, government bonds, business practice, industrial securities, legislation and taxation.

American Welding Society

THE fall meeting of the A.W.S will be held in Chicago, Monday, Oct. 2, to Thursday, Oct. 5. On Monday afternoon, all day and evening Tuesday, and Wednesday morning there will be papers and reports on welding practice. For Wednesday afternoon a joint meeting with the American Electric Railway Engineering Association is scheduled, with papers by C. A. McCune, president, and William Spraragen, secretary American Welding Society, and E. M. T. Ryder, way engineer, and J. S. McWhirter, superintendent of equipment Third Avenue Railway System. On Thursday morning there will be a meeting of the committee on welded rail joints on the Municipal Pier. Members of the A.W.S. will meet at the Hotel Morrison at 6 p.m. Wednesday for a get-together dinner.

Association Safety Activities to Be Co-ordinated

A MEETING of a joint committee representing the National Electric Light Association, American Electric Railway Association, American Gas Association, Pennsylvania Electric Association and the Bell Telephone interests was held during the Safety Congress at Detroit last month and means of co-ordination and prevention of duplication of the work of the safety and accident prevention committees of the several groups were discussed. The discussion developed the fact that many of the studies carried on are of common interest, and while the work of the individual committees cannot be interfered with some means of keeping intimate touch between the several committees is a necessity. After discussion of various methods a committee was appointed to prepare and submit for approval a plan that would meet the ideas expressed in the discussion.

American Association News

Judge Warwick and H. A. Wheeler Will Address Convention

A NOTABLE feature of the meeting of the American Electric Railway Association on Wednesday morning will be the address by Judge Walter Winter Warwick, whose acceptance has just been received by Charles C. Peirce of the committee on meetings and subjects. Judge Warwick was Comptroller of the Treasury during the war years of from 1915 to 1921. He has also been Judge of the United States Circuit Court, Associate Justice of the Supreme Court of the Panama Canal Zone, and a member from April, 1911, to May, 1913, of the President's Commission on Economy and Efficiency. He is now Assistant Director of the Budget, with headquarters at Washington, D. C.

Judge Warwick's topic will be "The Financing of Electric Railways."

Another prominent speaker who will address the convention on Tuesday morning is H. A. Wheeler, vice-president Union Trust Company of Chicago. Mr. Wheeler was formerly president of the United States Chamber of Commerce. Mr. Wheeler's topic will be "The Business Situation."

Claims Association Program

THE complete program of the Claims Association was made public this week, together with certain convention committee appointments. The latter are as follows: Convention assistants to the president, G. T. Hellmuth, Chicago, and H. O. Allison, New Brighton, Pa.; resolutions, W. H. Hyland, Gloversville, N. Y.; registration, H. D. Briggs, Newark, N. J.; entertainment, Wallace Muir, Lexington, Ky., and T. B. Donnelly, Connellsville, Pa.; reception and acquaintance, C. B. Proctor, Memphis, Tenn., and S. J. Herrell, Knoxville, Tenn. The program follows:

MONDAY MORNING, OCT. 2

Registration.

MONDAY AFTERNOON

HONORARY CHAIRMAN, J. R. GUILLIAMS

Invocation.
Address of President.
Report of Executive Committee.

Papers and Addresses

A Welcome.

"The Dignity and Fundamentals of Claim Work," By J. R. Guilliams, general attorney, Chicago Surface Lines.

"The Minimizing Expenditures Through Co-operation of Trainmen in Obtaining Observers," By P. O. Solon, claims attorney San Francisco-Oakland Terminal Railways.

"Personal Specifications for Claims Men," by H. O. Allison, safety engineer Beaver Valley Traction Company.

"Titles Which Suggest and Encourage Claims," by W. F. Weh, superintendent accident department, Cleveland Railway.

"Acts of Management and Operation Which Affect Claims," by J. W. Giltner, chief claim agent Northern Ohio Traction & Light Company.

"Claim Department Practices Which Encourage Claims," by Walter E. Robinson, claim agent Cincinnati Traction Company.

"Budgetary Procedure in Claims Expenditures," by John J. Reynolds, claims attorney Boston Elevated Railway.

"The Psychology of a Smile" (a presentation), by Augustus Baker, chief of adjustment bureau Receivers of Pittsburgh Railways.

"Clerical Routine and Forms" (an exhibit).

Resolutions.

Announcement of special features.

Distribution of souvenirs.

TUESDAY AFTERNOON

HONORARY CHAIRMAN, W. F. WEH

Papers and addresses

"How to Organize a Local Safety Council," by Charles B. Hardin, general claim agent United Railways of St. Louis.

"How to Organize Company Employees for Accident Prevention," by Victor T. Noonan, superintendent department of accident prevention, Cleveland Railway.

"How to Decrease Accidents without Special Organizations." by B. F. Boynton, claim agent Portland Railway, Light & Power Company.

"The Physician's Part in Accident Prevention" (author to be announced later).

"The Effect Upon Claims from Accident Prevention," a symposium by the following:

B. D. Haskins, claim agent and director of safety work, Chattanooga Railway & Light Company.

Neil W. Funk, superintendent of claims Louisville Railway.

L. A. Edwards, chief claim agent the Pennsylvania-Ohio Electric Company.

H. J. Vosburgh, claim agent Rochester, Lockport & Buffalo Railroad.

J. J. Sharkey, claim agent New York State Railways Rochester.

Nathan Abelson, claim and tax attorney, Empire State Railroad Corporation, Syracuse.

R. S. Messenger, claims and tax agent, Wilmington & Philadelphia Traction Company.

Thomas G. Aston, claim agent Washington Water Power Company, Spokane.

H. G. Winsor, superintendent of investigations and adjustments, Tacoma Railway & Power Company.

R. H. Hatfield, claim adjuster Sioux City Service Company.

Albert W. George, general claim agent The Connecticut Company, New Haven.

"The Prevention, Investigation, Adjustment and Defense of Automobile Accidents and Claims," a symposium by the following:

Edwin J. Paige, claim agent United Railways & Electric Company of Baltimore.

C. M. McRoberts, chief claim agent Los Angeles Railway.

A. E. Shaw, chief claims agent Montreal Tramways.

George H. Conklin, claim adjuster Augusta-Aiken Railway & Electric Corporation.

R. B. Campbells, general manager Arkansas Valley Interurban Railway Wichita.

Charles A. Blackburn, claim agent Butte Electric Railway.

Charles B. Prugh, claim agent Columbus Railway, Power & Light Company.

F. J. Gatrell, general claim agent Chicago Surface Lines.

E. F. Wynne, claim agent Georgia Railway & Power Company, Atlanta.

E. M. Raver, claim agent the Lincoln Traction Company.

Charles Oldenburg, general claim agent Chicago & Interurban Traction Company.

V. J. Waltz, claim agent Community Traction Company, Toledo.

Resolutions and Special Announcements.

WEDNESDAY AFTERNOON, OCT. 4

HONORARY CHAIRMAN, J. H. HANDLON, ESQ.

Papers and Addresses

"Women Jurors," author to be announced later.

"Tricks and Crimes of Ambulance Chasers," by Joseph S. Kubu, formerly secretary of the Claims Association and by John W. Yenson, claim agent Third Avenue Railway, New York.

"Exorbitant, Contingent Fees of Attorneys and Doctors, Their Effect and Legal Aspects," by Squire, Sanders & Dempsey, attorneys at law, Cleveland.

A Message from the American Bar Association.

A Message from the American Medical Society.

A Message from the Association of Railway Claim Agents.

A Message from the International Claim Association.

"Our Experience and Opinions," a symposium by the following:

B. J. Kernan, New Orleans, La.
Roane Waring, Memphis, Tenn.
C. E. Pickett, Waterloo, Iowa.
W. P. Napier, San Antonio, Tex.
W. W. Smithers, Philadelphia, Pa.
George H. Gordon, LaCrosse, Wis.
E. A. Nell, Kansas City, Mo.

"Jury Systems and the Need for Revision," author to be announced later.

Resolutions and Special Announcements.

THURSDAY AFTERNOON, OCT. 5

HONORARY CHAIRMAN, JOHN J. REYNOLDS

"The Economic Aspect of Claims Expenditures," by William G. Fitzpatrick, general claims attorney Detroit United Railway.

"The Result of 350 Jury Trials" (with graphic charts), by William G. Marshall, chief of litigation bureau, Receivers of Pittsburgh Railways.

"The Female Plaintiff with Subjective Complaints," by James Whitney Hall, medical legal expert, Chicago.

"Medical Testimony in Defensive Litigation, with Some Suggestions to Physicians," by William A. Challener, general attorney Receivers of Pittsburgh Railways.

"Medical Defense of Litigated Claims, with Some Suggestions to Trial Attorneys." by John Leeming, M. D., medical counsel, Chicago Surface Lines.

"Inspirational Review and Outline of Probable Trend of Claims Work," by J. H. Handlon, claim agent Market Street Railway.

"Report on an Association Code of Ethics," by R. A. Sears, general claims attorney Boston Elevated Railway.

Adoption of Revised Objects of the Claims Association.

Report of Resolutions Committee.

Election of Officers—Installation.

Appointment of Committees.

Adjournment.

Interurban Round Table

THE program for Thursday, Oct. 5, of the Transportation & Traffic Association shows an "interurban hour" at 3 p.m., in charge of E. C. Spring, general superintendent Lehigh Valley Transit Company. Below will be found the program of this discussion received from President L. H. Palmer, with the request that it be published in advance because of the potential value to be realized if the interest taken measures up to the topic itself.

"Meeting Highway Competition"—This subject should bring out the unfair conditions of competition, also the point, can the automobile be made a stimulant to interurban traffic?

"Economics in Operation"—This subject should bring out the savings of car mileage and platform labor, together with dead or layover time and plotting of schedules.

"Getting Increased Passenger Business"—This subject should bring out the necessity of publicity, together with such publicity mediums as are used.

"Getting Increased Freight Business"—This subject should bring out the necessity of publicity development the same as passenger business, together with comparative rates and service with steam roads.

"Developing Favorable Public Sentiment"—This subject should bring out the capitalizing of public good will and the commercializing of the industry.

"The Necessity for Departmental Co-operation"—This subject should bring out the close touch one department should have upon the other and the results accomplished by working together. Using the entire pay roll as a booster for the service. Having all realize they are part of the whole.

As this note is printed, the following have accepted invitations to take part in this round-table discussion: F. L. Butler, C. E. Morgan. H. A. Nicholl, F. D. Norviel and E. S. Wilde.

Standard Committee Passes on Technical Reports

AT A meeting of the Engineering Association committee on standards, held in New York on Sept. 7, those parts of the technical reports which required action by the committee were considered in detail. The reports brought up were those on buildings and structures, power distribution, way matters and equipment.

The committee recommended that plans of typical shop layouts, prepared by the committee on buildings and structures, be adopted as miscellaneous methods and practices and printed thus in the Manual. The subject of good current practice in the design and construction of small bridges, culverts and trestles was referred back to the technical committee for the formulation of suggestions as to standards.

Under the subject of power distribution it was decided to recommend the suspension of the present specifications for crossings of electric light, power supply and trolley lines with steam and electric railways, in view of the revision of the National Electrical Safety Code which is now under way.

A long list of recommendations by the committee on way matters was approved. These involved detailed changes in specifications with a view to harmonizing them with existing practice, and six new specifications for railroad spikes, bolts and tie plates.

A number of suggestions by the committee on equipment, particularly as to wheel contours, were referred to the convention for action.

The meeting was attended by the following members: Martin Schreiber, chairman; N. B. Trist, C. G. Keen, C. H. Clark, John Lindall, J. A. Brooks and H. H. Norris. The committees were represented thus: way matters, H. H. George and R. C. Cram; power distribution, M. B. Rosevear, C. R. Harte; equipment, H. A. Benedict (representing R. H. Dalgleish), Daniel Durie. G. C. Hecker was secretary.

Special Arrangements for Railroad Tickets This Year

THOSE intending to get the benefit of the reduced rate to and from Chicago should be sure to secure identification certificates from the association office before purchasing their tickets. The usual plan by which identification certificates can be obtained at any ticket office is not being followed this year. The certificates to be obtained from the association office permit the purchase from any railroad office of a round-trip ticket to Chicago for a fare and one-half. After arriving at Chicago the delegate must have his ticket validated by an agent of the railroad, who will be at the Municipal Pier. The ticket is good going to Chicago from Sept. 26 to Oct. 4, and is good for return until Oct. 12. On the New York Central and Pennsylvania Railroads the ticket is not good either going or returning on the 20th Century Limited or the Broadway Limited respectively.

News of the Electric Railways

FINANCIAL AND CORPORATE :: TRAFFIC AND TRANSPORTATION
PERSONAL MENTION

Politics Dragged Into Strike

Buffalo Company Carrying 100,000 Passengers Daily—Traffic on Many Lines 90 per Cent Normal

With the approach of the fall election, politics are being dragged into the strike of employees of the International Railway, Buffalo, N. Y., which has been in effect since July 1. Mayor Frank X. Schwab has thrown his support to candidates indorsed by the strikers, the jitney owners and the Nickel or Walk Club, which has been organized to fight for a reduction in the railway fare.

Despite the mud-slinging campaign with the International Railway and Mitten Management, Inc., as the targets, the number of passengers being carried on all local and interurban lines of the company is constantly increasing. Herbert G. Tulley, president of the company, says the company is now carrying more than 100,000 passengers daily and that riding is 90 per cent normal on a large number of the West Side lines in Buffalo. It is predicted that if the percentage of increase is continued, car riding will be normal on all lines within another four or five weeks.

Among the candidates indorsed by the strikers, the jitney owners and the Nickel or Walk Club is Robert C. Lacey, chairman of the board of arbitration of the Central Labor Council and former president of the organization, who is under arrest charged with the illegal possession of dynamite. The arrest was made at the time four strikers were taken into custody after the wrecking of the Buffalo-Niagara Falls high-speed line car by dynamite. Mr. Lacey is a candidate for the State Senate from a Buffalo district. Among other candidates indorsed by the strikers and running on a platform for home rule, the abolishment of the Public Service Commission and recall of judges is Leo F. Tucholka, an opponent of the International.

Unable to secure the necessary support and co-operation of the Police Department under Mayor Schwab, the International Railway is endeavoring to round up practically single-handed the jitney drivers who are operating illegally. Scores of arrests have been made by employees of the railway who have been sworn in as special officers. The arrests are made upon warrants issued by the City Court upon information obtained by International Railway employees who have secured the evidence against the jitney drivers. Fines ranging from $25 to $250 have been imposed upon those convicted and yet hundreds of jitneys are plying their trade unmolested by city police.

A second injunction against jitney drivers has been obtained by the company from Justice Pooley in Supreme Court. It names 624 individuals and was granted upon application of Henry W. Killeen, counsel for the International. The purpose of the second injunction is to cover the cases of suspected jitney drivers, who are not named in the first injunction. Justice Crosby had ruled that the first injunction applies only to those persons specifically named in the court order and cannot include "all others" as stated in the reading of the injunction.

By unanimous vote the City Council of Buffalo adopted a resolution appropriating funds for the legal battle to be started by the municipal authorities to force a return of the 5-cent fare on the local lines of the International. About $75,000 will be required to continue the fight before the Public Service Commission. The City Council was advised against proceeding with a rate case at this time especially in view of the fact that the Public Service Commission will take the earnings of the company for the last several months as a basis for a fare readjustment and as the company has had little revenue from fares during this period, an 8 or 10-cent fare might be fixed by the commission.

Despite the warning of the city's legal staff, the City Council voted to start the rate case and directed the city's legal department to begin a preliminary action for a lower fare. The Council voted to employ an expert to make an investigation into the financial condition of the railway and conduct a survey of its physical properties which will be used as a basis of a rate case.

$3,000,000 in Improvements Depending on Franchise Vote

As an opening gun in a campaign to have the people of San Diego vote favorably at the special election to be held Oct. 10 on the Sixteenth Street franchise and the proposed charter amendment to relieve the San Diego Electric Railway of paving costs in future, John D. Spreckels, president of the railway, has issued a statement in which he promises that the company will spend $3,000,000 in San Diego in extensions and improvements if the concessions asked are granted and the company is given "a fair chance to do business under modern and reasonable conditions."

In his statement Mr. Spreckels said that his railway as a public utility was simply seeking a franchise which will relieve it of obsolete requirements. He said that a negative vote on the franchise issue would compel the railway to fall behind while all other utilities were making plans with future prosperity on every hand.

Electrification Accepted

Alternative Proposal of Mr. Hobson to Equip Texas Steam Road Approved by Dallas

The city of Dallas has approved the proposal submitted by C. W. Hobson and his associates for the electrification of the Missouri, Kansas & Texas Railroad from Dallas to Denton and its use as an interurban. The offer from Mr. Hobson was made in lieu of constructing the second interurban of 30 miles in length which Mr. Hobson and other grantees of the street car franchise at Dallas agreed to build under the terms of the contract entered into with the city at the time the franchise was granted in 1917. Mr. Hobson and associates are to enter into a fifty-year contract with the Missouri, Kansas & Texas, and the work of electrifying the line is to be begun by Oct. 1. Service is to be begun by the summer of 1923.

The question of carrying out the work was put squarely up to the City Commissioners and the Mayor of Dallas. The Dallas Railway is under bond to build an interurban at least 30 miles in length out of Dallas, work to begin this month, and C. W. Hobson has posted with the American Exchange National Bank, Dallas, a certified check for $350,000 as forfeit to guarantee the carrying out of the contract for a new interurban line.

After the traction people had investigated the proposition to electrify the Missouri, Kansas & Texas from Dallas to Denton and had made surveys and estimated costs, etc., Mr. Hobson formally notified Mayor Sawnie Aldredge and members of the City Commission that the traction interests would forfeit the $350,000 if the city declined to accept the Katy electrification project in lieu of the new interurban line which they are under contract to build.

Sentiment in Dallas seemed divided as to whether the city should accept or reject the Katy electrification project. Some people suggested that the project be rejected and that the $350,000 forfeit money be taken and used to acquire and equip a large park near the city. Others suggested that the forfeit money be accepted and used as a nucleus for a fund to be used in building an interurban line from Dallas to Greenville.

Mr. Hobson in notifying the city of the determination to forfeit the $350,000 submitted a draft of the proposed contract between the interurban interest and the Missouri, Kansas & Texas Railway. The contract gives the interurban interests a lease on the railway line for a period of fifty years with exclusive rights for hauling passengers, while the steam railway retains the right to haul freight.

Voters of Grand Rapids Approve New Franchise

Eighteen Months Consumed in the Negotiation of Terms Which Have Been Overwhelmingly Approved at Polls—Initial Fare Ten Cents Cash

A NEW electric railway franchise, effective for thirty years and carrying many unique provisions, has been granted the Grand Rapids (Mich.) Railway as a result of an election held there on Sept. 12. The measure was drawn up jointly by representatives of the municipality and the company. The nature of the grant was such as to require a three-fifths majority to assure passage. When final results of the election were known, however, it was found that the majority for the franchise was nearer four-fifths. Out of seventy-three precincts in the city, seventy-one carried the measure.

In the course of an interview with a representative of the *Electric Railway Journal*, Louis J. De Lamarter, vice-president and general manager of the company, made the following statement:

> The result of the franchise vote is particularly gratifying in view of the fact that at no time since the citizens of Grand Rapids have had the franchise under consideration has the railway given the public to understand that passage of the measure would bring an immediate reduction in fare or prompt improvement in service. We have indicated, to be sure, that the defeat of the grant would entail further financial hardships on the company and render still more difficult the expansion and development of our properties.
>
> We, therefore, are more than pleased with the spirit of co-operation and fair play manifested by the people of Grand Rapids in so stanchly supporting the measure. We feel, now, that the officials of the city, in collaboration with those of the company, are in a position to proceed with the solution of the various problems presenting themselves, and that the time is not far distant when Grand Rapids citizens may enjoy an improved transportation service.

Negotiations leading up to the enactment of the new franchise ordinance in Grand Rapids have been pending since the expiration of the old franchise on April 23, 1921. The factor which presented the knottiest problem to the group of experts representing both the city and company was the equitable valuation of the property. The city was unwilling to accept the valuation figures presented by the management of the company and the company maintained that the city's figures were altogether too low. Nearly a year's time was spent in threshing the matter out, the company holding strong for an $8,000,000 valuation, as contrasted with $5,100,000, the figure named by the city. The company finally agreed, however, to accept a compromise valuation of $5,500,000, provided the new franchise ran for thirty years, with an 8 per cent return. The company owns and operates extensive recreation grounds at Ramona and North Parks and these properties were included in the valuation.

The rate of fare to be charged was another knotty problem. Several methods were considered, ranging from the sale of one cash fare for 7 cents, four tickets for a quarter, to 10 cents cash fare and seventeen tickets for a dollar. This latter rate eventually gave way to the one now in effect, which provides that the initial fare shall be 10 cents cash and that seven tickets shall be sold for 50 cents. The new franchise stipulates that the present rate shall continue until the company's earnings exceed 8 per cent, whereupon the rate of fare shall decrease, step by step, as earnings increase, until a minimum fare of 5 cents shall have been reached with thirteen tickets for 50 cents. It also is provided, however, that, regardless of earnings, the maximum cash fare shall not be more than 10 cents. The intermediate rates are 10 cents cash and four tickets for a quarter, 10 cents cash and nine tickets for 50 cents, 10 cents cash and five tickets for 25 cents, 5 cents cash,5 cents cash and eleven tickets for 50 cents, 5 cents cash and six tickets for 25 cents, 5 cents cash and seven tickets for 25 cents. On the rate of return the grant provides:

> The grantee's initial rate of return on the value of its property as determined under Sections 16 and 17 of this franchise shall be 8 per cent per annum. The grantee's rate of return shall be decreased one-quarter of 1 per cent whenever the rate of fare shall be increased one step as hereinafter in this section defined; when the cash or ticket fare in effect shall be less than 5 cents the return to the company shall be increased one-quarter of 1 per cent for each step the same is reduced.

City Has Purchase Rights

Another important provision of the franchise is that the city is given the right to purchase all of the company's properties after fifteen years or at the end of any five-year period thereafter or at the expiration of the franchise, the purchase to be negotiated on the basis of the present valuation or any valuation figure hereinafter arrived at, allowance being made for depreciation as well as additions and improvements.

The company is required to make monthly reports to the city and the company's books always are to be open for inspection by the city's authorized representatives. The city also is given the supervision of the salaries paid the company's officers and the company is enjoined from securing any indirect revenue whatsoever.

It is provided in the new franchise that any essential differences or disputes arising between the city and the company shall be settled by arbitration, the arbiters to be equally representative of both factions and their decisions to be final and conclusive.

The city has absolute jurisdiction over service, being empowered to fix the frequency with which cars shall run on all lines.

Ever since the provisions of the new franchise were made public, following approval by the City Commission on June 12, 1922, the measure has received the unqualified support of every forward-looking organization in Grand Rapids. All of the city's newspapers, the Chamber of Commerce, Rotary Club, the Trades and Labor Council and several business associations devoted their whole-hearted efforts to campaign activities in behalf of the franchise.

During the campaign Mr. De Lamarter played an open hand with all his cards on the table and the election results are interpreted as clearly demonstrating the people's appreciation of such tactics. As an after-election editorial in a Grand Rapids paper stated, "the people are fair when appealed to fairly."

Fare Equalization Fund Provided

The provisions of the grant covering the fare equalization fund established is as follows:

> Sec. 21. The grantee, as soon as this franchise goes into effect, shall open a bookkeeping account denominated "Automatic Fare Equalization Account" hereinafter referred to as the "Equalization Account." The grantee shall thereafter credit the "Equalization Account" with all income received from the operation of the property and from all other sources, including the earnings on any reserve funds accrued subsequent to Jan. 1, 1922, or which may hereafter be set up, including all earnings on the net balance in said equalization account, in excess of the actual cost of operation as defined in Section 22, and shall debit said account with the return to which the said grantee is entitled under the provisions hereof.
>
> Whenever there shall be a net debit of more than $50,000 to the equalization account, then the next higher rate of fare and the next lower rate of return shall be and become effective; whenever there shall be a net debit exceeding $100,000 to the equalization account, then the next higher rate of fare and the next lower rate of return shall be and become effective and the rate of fare shall be further increased from time to time in like steps until the debit to the said equalization account is wiped out. Whenever the net credit to the equalization account exceeds $50,000 the next lower rate of fare shall be and become effective; whenever the net credit exceeds $100,000 the next lower rate of fare shall be and become effective and all amounts to the credit of the equalization account in excess of $100,000 shall be used as a basis for further reductions in fare and in like steps.
>
> All increases and all decreases in the rate of fare shall be made on the first day of the second month following the one in which the results of operation show that such increase or decrease is demanded under the terms hereof; Provided, however, the grantee in order to avoid frequent changes in the rate of fare or an increase in the rate of fare which in its judgment may decrease its gross earnings, may to such an extent as it may be able or deem expedient, and subject to the approval of the City Commission, refrain, from time to time, from debiting the equalization account the full return to which it may be entitled, but to such extent as it does so refrain it shall be entitled to debit said account, without interest, before a reduced rate of fare shall be established under the terms hereof. Any tickets outstanding when change of price thereof is made shall be redeemed by the grantee at the price at which the same were sold.

Another Effort to Restore Service in Saginaw

Another effort is to be made looking to the resumption of electric railway service in Saginaw, Mich. Initiatory petitions are being circulated calling upon the Council to submit to the voters at the general election on Nov. 7 a franchise ordinance to Otto Schupp, trustee in bankruptcy of the Saginaw-Bay City Railroad. The term of the grant is twenty-five years. Mr. Schupp represents the holders of more than $400,000 of first mortgage bonds on a property that has not been in operation since Aug. 10, 1921.

Under the terms of the proposed ordinance the rates of fare for the first two years are to be: twenty tickets $1, four tickets 25 cents, 10-cent cash fare, free transfers. After the expiration of the initial two-year period, the rates are to be fixed by the State Public Utilities Commission. The operators of the property agree to rebuild certain of their tracks next year, keep the pavement between the tracks in repair and operate motor coach extensions to various parts of the city not served by the electric railway.

Jitney bus and intercity motor bus competition along the lines of the Michigan Railroad is prohibited.

It is further provided that in case of any disagreement between the city and company that can not be adjusted amicably the question in dispute is to be submitted to the Public Utilities Commission for settlement. The city is to have the right to purchase the railway property at any time at a price to be fixed by arbitration. The company is not to be required to pay for paving or repaving other than the extra ballast required because of the presence of its tracks in the streets.

Five-Mile Interurban Extension by Pacific Electric Railway

Announcement has been made by D. W. Pontius, vice-president and general manager of the Pacific Electric Railway, that application will be made immediately to the California State Railroad Commission for authority to extend the company's Monrovia-Glendora interurban line from Glendora to San Dimas, which is approximately 5 miles. This proposed extension will close up the gap between the Monrovia-Glendora Line and the San Bernardino Line.

The new extension will be constructed as soon as permission is received from the Railroad Commission. When completed it will shorten the route from South Pasadena, Pasadena, Sierra Madre, Monrovia, Azusa and Glendora to San Dima, Pomona, Ontario, Upland, Riverside, Redlands and the San Bernardino district and will result in a considerable saving of time to passengers. It will also expedite freight shipments.

It is estimated that after the Railroad Commission acts favorably on the company's application work on the proposed extension will be started at once and that it will be completed within four or five months. The expenditure to be made for carrying out this work will be about $370,000. The construction of the line will be the first extensive addition to the electric interurban lines made by the company since before the war.

Prior to the war, the Pacific Electric Lines purchased the right-of-way for the purpose of making this line extension to a connection with the San Bernardino line at San Dimas; but during the war all railway construction was held up as a war measure. It has not been feasible to attempt any further construction prior to the present time.

Compulsory Arbitration Bill Introduced

A bill for the compulsory incorporation of labor unions and compulsory arbitration of industrial disputes has been introduced in the House by Representative Fairchild of New York and referred to the committee on labor, which will consider it at the December session of Congress.

The measure would provide that all labor unions be enrolled as "national unions" under the Department of Labor, for which purpose the bill would create the office of commissioner of enrollments, with an annual salary of $7,500 a year. Employers of more than twenty-five workers also would be obliged to enroll. A penalty in the form of a tax of $5 a year would be levied upon all members of unions not enrolled in the national union.

The national unions, to be organized according to occupations, would be obliged to write into their by-laws a provision against disturbing the regular commercial life of the country and agree to submit all controversies which cannot be composed by private negotiation to the courts of the United States and to accept their decision on final appeal without further controversy.

A violation of the latter clause would be considered a misdemeanor punishable by a fine of $5 a day and no employer would be able to hire a worker not a member of a national union on penalty of fine of $5 a day for each outside worker employed.

Differences in Ottawa Settled

F. D. Burpee, general manager of the Ottawa (Can.) Street Railway, and F. W. McRae, president of Amalgamated Division 279, signed an agreement on Sept. 14 which brings to a final settlement the differences between th railway management and the men. The settlement is based on the finding brought in about three months ago by the Board of Conciliation and Investigation and has nothing to do with wages. No dispute has arisen in this respect since the finding of the board which reduced wages 12½ per cent. This decision was referred to in the *Electric Railway Journal*, issue of June 3. The chief clause in the new agreement states that the company will treat with its men through their properly accredited representatives of the Amalgamated upon questions which may arise, including dismissals after suspension. It is understood, though, that the company reserves the right to treat separately with men who are not members of Division 279 of the Amalgamated.

Reported Rehearing Petition Will Be Denied

Denial of the petition of the city of Indianapolis for a rehearing of the case in which the Indiana Public Service Commission relieved the Indianapolis Street Railway from paying for paving between its tracks appears likely. The question is one of prime importance in Indiana, since most cities require the street railway to pave streets and keep in repair the paving between their tracks and 18 in. on each side. At the conclusion of the arguments, Edgar Blessing, a member of the commission who wrote the original order, said he personally favored denying the petition to reopen the case. It is regarded as likely that other commissioners will take the same attitude. Counsel for the railway declared that the commission, the Legislature and the city had no authority to compel the railway to pave between its tracks. He said there was sufficient authority for the city to provide for the paving out of the general fund.

The Sporting Mayor of Indianapolis

How times have changed! Recently while Mayor Lew Shank of Indianapolis adorned the Tippecanoe County Fair racetrack rail and rooted for Peter Hall, a trotting horse owned by his wife and others, the mayors and city attorneys of a score of other Indiana cities assembled in Indianapolis and formed the Public Utilities Committee of Indiana Cities, an organization Lew had demanded since his memorable citizens' march last spring on the Statehouse to denounce the Public Service Commission. Mayor John C. Quick of Muncie, with whom Lew joined in the call for the organization meeting, could not explain the Indianapolis Mayor's absence. He did not attribute Lew's lack of enthusiasm to the latter's "peace visit" to the commission's office the day before when Mr. Shank and the members of the Indiana Public Service Commission gave every evidence of having patched up their difficulties.

In the organization of the public utilities committee Mayor Quick was elected president, Taylor Groninger, corporation counsel of Indianapolis, vice-president, and J. N. Brissey, city attorney of East Chicago, secretary-treasurer. The committee will work in conjunction with the Indiana Municipal League, it was said. The movement was started this year when Lew fought a proposed merger of several electric companies and opposed increases in utility rates. The annual meeting will be held the first Wednesday in September each year.

Construction of Bay Shore Interurban in Prospect

Acceptance of the franchise offered by the City Commission of Houston to the promoters of the proposed new interurban electric railway is said to insure the construction of the line. John Henry Kirby, wealthy lumber manufacturer and oil operator; W. C. Munn, John S. Bonner and Jacob F. Wolters, all of Houston, are the organizers of the Bay Shore Interurban Railway Company, and they have given bond in the sum of $7,500 to the city for the faithful performance of the franchise and contract. Under the terms of the franchise, work on the new line must begin by March, 1923, and cars be in operation by the first of 1924.

The city of Houston will secure a franchise from Harrisburg which will permit the new line to connect with the tracks of the Galveston-Houston Interurban Company at the point where it leaves the tracks of the Municipal Belt Railroad.

The Bay Shore Line will use a quarter of mile of the Municipal Belt track and part of the right-of-way of the municipal railroad. Under the franchise the city has the right to purchase an interest in the right-of-way which will be secured by the interurban line beyond the Municipal Belt Railroad so that the railroad can be extended if the city should desire.

Subway for Tokio in Prospect

An underground electric railway will soon be part of the life of Tokio if plans now under way come to a successful termination. The Tokio Underground Railway, Ltd., recently issued a prospectus in which the fact was brought out that the electric railway operated by the Municipal Electric Bureau is insufficient to carry the vast throngs of people which have been increasing in alarming numbers.

The statement is made that the projected line of the underground railway is to have connections with the high-speed electric railway system operated by the government Department of Railways between the capital and Yokohama. The subway will be extended 9½ miles.

Board of Estimate Receives Mayor's Plan of Construction

In a recent statement to the Board of Estimate John F. Hylan, Mayor of New York, as part of his rapid transit construction program, has promised the construction of seven tracks within the next five years, which will relieve the present congestion on the upper west side. The first stage in the construction of the new west side line will be the operation of the line from Fifty-ninth Street and Seventh Avenue to Broadway and Dyckman Street. The next step will be the continuation of the line as a four-track main line south on Amsterdam Avenue from Seventy-second Street to the Battery and Brooklyn. The third stage will be the extension from Broadway and Dyckman Street to Yonkers. According to the Mayor's statement when these three stages are completed the city will have another four-track subway running through the entire west side with a two-track connection with the present Broadway subway.

It was announced at the second public hearing on Mayor Hylan's plan for new subways that estimated cost of constructing new west side line from Seventy-second Street and Amsterdam Avenue to the Battery is $31,000,000.

Wages Go to Arbitration

A typographical error, in which an entire line was dropped from the story on page 407 of the *Electric Railway Journal*, issue of Sept. 16, with respect to the wage controversy between the management and employees of the Boston & Worcester Street Railway, destroyed the sense of that item. The sentence should have read: "Several conferences were held previous to the expiration of the contract and it was agreed that all articles of the contract other than articles pertaining to wages were satisfactory." As indicated previously, the wage matter has gone to arbitration for settlement.

Joint Engineering Council Formed

Proposals have been approved by representatives in conference of the leading British engineering institutions for closer co-operation between these bodies. They are the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Naval Architects and the Institution of Electrical Engineers. An Engineering Joint Council composed of representatives of the four bodies has been formed. The objects in view are to improve the status of engineers, to secure the better utilization of their services in the country's interests, to secure the appointment of properly qualified individuals to responsible engineering positions and to prevent unnecessary duplication of activities.

Proposed Expenditures in Tennessee Total $2,000,000

Public utilities of Tennessee will spend more than $2,000,000 within the next year in improvements and renewals. Figures giving this amount have been supplied the State Utilities Commission following a resolution of the commission to review all construction plans and determine what progress has been made. The contemplated expenditures of the railway companies in the state are as follows:

	Estimated Sum to Be Spent During Current Year	Sum Spent in Past Six Months
Knoxville Railway & Light Company	$250,000	$136,000
Chattanooga Railway & Light Company	175,000	100,000
Memphis Street Railway	200,000	100,000
Tennessee Power Company	300,000	65,000
Nashville Railway & Light Company	300,000	100,000

Co-operative Welfare Association Entertains Employees and Their Families

On July 5 the Louisville (Ky.) Railway chartered the steamer *East St. Louis* for three trips of three hours each on the Ohio River for the employees of the company, their families and their friends.

There were 900 people on the morning boat, which left the wharf at 9:30 a.m. This boat carried the late trick employees and their families, as it was planned to give every employee of the company an opportunity to make the ride. Motion pictures were taken of a special car discharging passengers for the morning boat ride, of the people approaching and boarding the boat and also showing the *East St. Louis* backing out into midstream. These pictures are a part of a film that the company is preparing of all of its activities and will be shown at gatherings of employees during the fall and winter.

The offices and shops closed for the afternoon, and as many as it was possible to relieve went on the afternoon trip. There were 1,218 passengers on the afternoon boat, leaving the wharf at 2:30 and returning at 6 p.m.

The evening boat, leaving the wharf at 8 p.m. and returning at 11:30 p.m., of course, carried the largest crowd. The capacity of the boat being 1,800 people, the government inspector insisted on raising the gangplank after 1,775 people had boarded the boat. Quite a number were disappointed but other entertainment features carried out during the summer made up for the loss.

On July 7 there was a boat ride for the colored employees of the company on the steamer *America*, leaving the wharf at 2:30 p.m. and returning at 6 p.m.

On Aug. 2 Fontaine Ferry Park, an amusement resort on the Ohio River, was taken over by the company for an all-day outing for white employees and families. The park was opened at 10 a.m. and employees were urged to pack lunch baskets and bring the kiddos, wives, fathers, grandfathers and grandmothers and spend as many hours at the park as possible.

There was a program of music in the bandstand at 1:30 p.m. and 8 p.m., with a radio concert at 7:30 p.m., as well as contests for the boys and girls at 2:30 p.m. Moving pictures were taken of all events at the park.

Free tickets were provided, covering carfare to and from the park, admission to the park and rides on most of the amusement devices in the park.

Invites Public Criticism.—In an effort to render a faithful and efficient service to its passengers the North Carolina Public Service Company, Greensboro, N. C., has invited the patrons of its lines to send in service suggestions. Constructive criticism is sought as the first step toward improvements in the railway department of the company.

Financial and Corporate

Elevated Merger Sanctioned

Illinois Commission Has Approved the Chicago Merger—Move a Measure For Greater Simplicity

Permission was granted on Sept. 14 by the Illinois Commerce Commission for the proposed $76,000,000 merger of the Northwestern, Metropolitan and the South Side elevated lines and for the purchase by the consolidated corporation at a judiciary sale of the properties of the Chicago & Oak Park Elevated Railroad, which has been in the hands of a receiver since Nov. 13, 1911. A meeting of the stockholders of the three companies will be held later in the month to ratify the consolidation plan.

In citing benefits to be derived through the merger, the elevated railroads, in their petition filed with the commission last May, stated the lines could be operated more efficiently and economically as one company, and that the proposed consolidation would better the credit and raise the financial standing of the properties and enable the company to purchase new equipment.

One Hundred New Cars

The consolidation will permit the company to go forward with its plan of purchasing 100 new cars at a cost of $23,000 each. A petition to purchase the new equipment was filed with the commission a few days ago.

Britton I. Budd. president of the roads, said the consolidation will mean an improvement in service.

We will start service with longer trains shortly after March 1, when delivery of the new cars will begin. Such service will be of great benefit to the public during rush hours. This involves lengthening of station platforms and several other physical changes.

Because of inability to attract new capital and because of closed mortgages the elevated lines have not developed to anything like their potential ability to give the people the service which is the crying need of the hour. This is the first step in that direction.

The valuation of all the elevated lines for rate-making purposes as of June 30, 1919, was $86,250,000. Since then additions to capital have increased the value to $86,682,899. The proposed consolidation corporation is to have stocks and bonds of $76,106,500, which will be increased to $83,806,500 with the acquisition of the Oak Park line.

The merger will eliminate $2,936,815 of floating indebtedness and $2,984,581 of receivers' liabilities. The consolidated corporation is authorized to make a first lien and refunding mortgage of $1,600,000 and an adjustment income mortgage of $17,120,000, and to issue $19,172,500 in capital stock with which to retire the stock of the three companies and pay off indebtedness. It is also authorized to issue $2,600,000 in stock to cancel certain receivers' liabilities in connection with the purchase of the Oak Park "L."

Fails to Meet Cost of Operation

Owing to heavy reconstruction and other maintenance expenses the Boston (Mass.) Elevated Railway was unable to earn its cost of operation last August, falling $217,128 behind. It carried 26,877,682 revenue passengers of whom 6,001,000 were carried for the 5-cent fare and 20,876,682 for the 10-cent fare. The total receipts from operation amounted to $2,443,075 and the cost of the service was $2,660,204. The payroll cost per revenue passenger was 4.759 cents as against 5,287 cents in August a year ago. The cost of service per revenue passenger was 9.898 cents as against 10.546 cents in August last year. The trustees report that the work is well advanced on 100 new surface cars and shipments will begin at the end of September. Since Jan. 1 the company has overhauled and painted 571 cars and snow plows, as compared with 389 during the same period last year.

New Merger Bill

Another Measure Has Been Introduced Designed to Effect Consolidation of Washington Companies

A new bill for the voluntary merger of the electric railway and electric power companies of Washington, bearing the indorsement of the District of Columbia Public Utilities Commission, has been introduced in the House by Representative Focht. It is understood that this measure will be urged before the District of Columbia committee to displace the several other bills on this subject which are pending before that body, two of them having been passed by the Senate.

Voluntary Consolidation Proposed

The Focht bill would provide for the voluntary consolidation of all the railway companies of the capital city upon a vote of three-fourths of the stockholders of each of the separate corporations. It would provide that consolidation with the Potomac Electric Power Company could not be had as a separate merger by any of the individual railways, but would have to be effected, if at all, after the consolidation of the car lines. The measure also would provide means for consolidation of the Washington Gas Light Company and the Georgetown Gas Light Company.

Gross Receipts Tax Repealed

The 4 per cent gross tax on receipts would be repealed after July 1, 1922, and the bill would levy a tax of 50 per cent on net operating income in excess of 6 per cent and not above 7 per cent and a tax of 75 per cent on net operating income in excess of 7 per cent of the fair value of the property of all traction companies, The measure would relieve the traction companies, if consolidated, from paying the cost of street paving 2 ft. on each side of the tracks and between the rails and after consolidation would reduce the tax on net income to 4 per cent on gross revenue.

A clause in the new bill would empower the Public Utilities Commission to control the salaries of officials of the merged properties.

	Latest	Month Ago	Year Ago	Peak	1913
Street Railway Fares*	Sept. 1922 **7.01**	Aug. 1922 **7.01**	Sept. 1921 **7.21**	May 1921 **7.24**	**4.84**
Street Railway Materials*	Aug. 1922 **189**	July 1922 **181**	Aug. 1921 **160**	Sept. 1920 **247**	**100**
Street Railway Wages*	Sept. 1922 **208**	Aug. 1922 **209**	Sept 1921 **215**	Sept. 1920 **232**	**100**
Steel Unfilled orders (Million tons)	Aug. 31 1922 **5.95**	July 30 1922 **5.78**	Aug. 31 1921 **4.53**	Apr. 30 1917 **12.18**	**5.91**
U.S. Bank Clearings Outside N. Y. City (Billions)	Aug. 1922 **12.34**	July 1922 **12.30**	Aug. 1921 **11.08**	March 1920 **18.54**	Av. Mo. 1913 **6.12**
Business Failures Number	Aug. 1922 **1,669**	July 1922 **1,568**	Aug. 1921 **1,642**	Jan. 1922 **2,722**	Av. Mo. 1913 **1,213**
Liabilities (millions)	**36.83**	**42.15**	**50.38**	**105.7**	**24.64**

Conspectus of Indexes for Sept., 1922

Compiled for Publication in this Paper

by

Albert S. Richey

Electric Railway Engineer

Worcester, Mass.

	Latest	Month Ago	Year Ago	Peak	1913
Eng. News-Record Construction costs	Sept. 1922 **185.0**	Aug. 1922 **173.4**	Sept. 1921 **188.3**	June 1920 **273.8**	**100**
U.S. Bur. Lab. Stat. Wholesale Commodities	Aug. 1922 **155**	July 1922 **155**	Aug. 1921 **142**	May 1920 **247**	**100**
Bradstreet's Wholesale Commodities	Sept. 1 1922 **12.08**	Aug. 1 1922 **12.07**	Sept. 1 1921 **11.09**	Feb. 1 1920 **20.87**	**9.21**
Dun's Wholesale Commodities	Sept. 1 1922 **172.5**	Aug. 1 1922 **173.6**	Sept. 1 1921 **162.6**	May 1 1920 **263.3**	**120.9**
U.S. Bur. Lab. Stat. Retail food	Aug. 1922 **139**	July 1922 **142**	Aug. 1921 **155**	June 1920 **219**	**100**
Nat. Ind. Conf. Bd. Cost of living	Aug. 1922 **154.5**	July 1922 **155.6**	Aug. 1921 **162.0**	July 1920 **204.5**	(1914) **100**

*The three index numbers marked with an asterisk are computed by Mr. Richey, as follows: Fares index is average street railway fare in all United States cities with a population of 50,000 or over except New York City, and weighted according to population.

Street Railway Materials index is relative average price of materials (including fuel) used in street railway operation and maintenance, weighted according to average use of such materials. Wages index is relative average maximum hourly wage of motormen and conductors on 105 street and interurban railways in the United States, operating more than 100 passenger cars each, and weighted according to number of cars.

Traffic and Transportation

Read While You Ride

Newspaper Vending Machine Installed on Dayton Cars Attracts Attention from Railways Elsewhere

Increased interest has been aroused in other cities in the system of vending newspapers which has been in successful use on street cars in Dayton, Ohio, now for many months. The plan is known as the Read-Wyl-U-Ryd Street Car Selling Plan for morning papers. The two largest of the five street railways in Dayton at first agreed to install the system without any return to themselves, but the Dayton *Journal* subsequently agreed to give the companies a selling commission of one-half cent for each copy sold.

Both William L. Smith, general manager of the Dayton Street Railway, and W. E. Boileau are on record as being strong proponents of the Read-Wyl-U-Ryd boxes. In fact, in a letter to the Dayton *Journal* Mr. Smith said that he would gladly recommend the idea to any street or interurban railway. In granting permission to put the boxes on the cars of his company Mr. Smith said he did so because his action:

1. Afforded his patrons the opportunity to read the morning paper while riding to office or factory, which, from personal experience, was a pleasure and tended to shorten the ride.
2. Prevented his patrons being annoyed by newsboys, and, what was more essential, eliminated the possibility of an accident to such boys who carelessly and thoughtlessly jumped on and off the cars.
3. Added to the pleasant relations which existed between the press and the company, and further proved the desire of the railway to co-operate with the newspapers in giving "service" to the public.

Mr. Boileau said:

The boxes have proved very popular with the car riders in the morning, enabling them to obtain the morning paper when they get on the car and they are thus enabled to read it while en route to their office. A great many of our passengers have commented very favorably on the enterprise of both the Read-Wyl-U-Ryd Company and ourselves. It is our opinion that the plan fills a long-felt want and the increase in the number of papers taken from the boxes each morning indicates their increasing popularity.

Thomas E. Howell, general manager of the City Railway, is also an advocate of the use of the system. In fact, the new system of vending the papers was the outcome of an order issued by Mr. Howell a year ago to keep all newsboys off the cars of that company. This order followed personal observation by Mr. Howell of a Dayton *Journal* boy who boarded a car at a regular stop, proceeded through the car and after selling several papers walked to the front, pulled the lever which opened the doors and jumped off while the car was in motion.

This order by Mr. Howell was a measure of self-protection by the railway manager, but it affected the circulation figures. Therein Mr. Howell had reckoned without taking into account C. D. O'Rourke, the circulation manager of the Dayton *Journal*. Mr. O'Rourke was quick to see Mr. Howell's stand from the safety point of view, and Mr. Howell was equally quick to see Mr. O'Rourke's point of view when the circulation manager suggested the self-service newspaper box idea, which Mr. O'Rourke has since fully developed.

New Interurban Rates Arranged

The Louisville (Ky.) Railway which operates the Louisville interurban lines as well, has arranged for a new form of tariff on its interurban lines. The rates are and have been on the basis of 3 cents a mile all along, but under the old method the fare to the city limits was figured at 5 cents. Now there will be a minimum fare of 7 cents figured from the city limits to any point inside of the city. From the city limits the lines will be divided into zones of one-third of a mile each, all stations within a given zone being given a number, which will also represent the amount of fare necessary to go to that station from the limits or from the city limits to the station. Then 7 cents is added to the station number on fares to the city depot. This system makes it easier for the conductor as well as customers to figure the fare, and is a more equitable basis for the customer in that the rate is 1 cent for a third of a mile plus the city fare.

Under the new plans going into effect on the local lines in the city of Louisville children under five years of age will be hauled free, the age limit having been raised from three years, at which it had been held probably from the time that street cars were first operated in Louisville.

Bargain Beach Days Increase Good Will

As an advertising feature and to give the families of workingmen a chance to enjoy the beaches, Claus Spreckels, manager of the San Diego (Calif.) Electric Railway, started "bargain beach days," when a flat rate of 10 cents for the round trip was granted every Thursday during August to any of the San Diego beaches. The move proved so popular that the first two Thursdays in September were also made "bargain beach days," and when Mr. Spreckels' attention was directed to the fact that many working people could not get away during week days, two Sundays in September, the tenth and seventeenth, also were included. This makes a round trip fare of 10 cents, from outer or inner zone, as compared with regular fares as follows: Coronado, outer zone, 25 cents; inner zone, 20 cents; Ocean Beach or Mission Beach, outer zone, 30 cents; inner zone, 25 cents.

Manager Spreckels announced that the plan had been a huge success and though it might not have shown a profit financially (returns not yet tabulated) it proved wonderful in adding to the good will toward the company.

Five-Cent Issue Falls Flat

Even ex-Governor Eugene N. Foss of Massachusetts Is Unable to Arouse People There—Issue Dead

Boston has had another 5-cent fare experience. It was promised by a number of politicians, including former Gov. Eugene N. Foss, that if they were elected to public office they would secure the 5-cent fare on the Boston Elevated. The side which had been clamoring for the nickel fare during the campaign did not figure very prominently in the primary election returns, but on Sept. 18 the issue came to a more clear-cut test.

Public Hearing Poorly Attended

On that date the Massachusetts Public Utilities Department gave a public hearing on the 5-cent fare question, as directed by the Legislature, and found practically no representatives of the public on hand to advocate the idea. The commission waited a considerable time before anybody appeared at the hearing, except some railway officials, and Chairman Attwill commented on the fact that there had been so much talk about the fare reduction in the political campaign and now all the advocates of the issue seemed to desert it when a tribunal which had authority to act on it met to afford them an opportunity to discuss it on its merits. The commission had set aside two days, with two sessions each day, for the presentation of this cause, and nobody appeared to urge it or discuss it.

Only two speakers appeared. They were the city solicitor of Malden, who opposed the 5-cent fare as provided for in the bill which Mayor Curley of Boston presented to the Legislature, and the city solicitor of Somerville, who merely contended that a mistake was made in not holding the Boston Elevated Railway to the twenty-five year contract which provided for a 5-cent fare.

Issue Went by Default

Although the issue went practically by default the commission decided to give the public one more opportunity to come forward and discuss the fare situation, setting aside Sept. 21, for the purpose.

Council Condemns One-Man Cars

In a resolution passed by the Council of Clarksburg, W. Va., operation of one-man street cars in the city is condemned as being dangerous to life and health and as tending to reduce a servive the public should have from a public utilities corporation. The city attorney was instructed to take such action as he deemed necessary against the Monga-hela Power & Railway Company, which operates the electric railway system in this city.

Training Plan Successful

Efficiency Superintendent Describes Plan Which Has Improved Morale of Dallas Railway's Trainmen

Some time ago the Dallas (Tex.) Railway asked C. J. Crampton, director of the Dallas Chamber of Commerce, department of industrial efficiency and vocational training, to assist in the study and solution of its difficulties. Accordingly Mr. Crampton, who is now superintendent of the safety and efficiency department of the railway, made a detailed analysis of conditions and worked out, in lesson form, the various duties of trainmen. A capable superintendent of employment and training was employed with the understanding that he co-operate and carry out Mr. Crampton's plans. Employment tests were instituted. These included mathematical tests, general intelligence tests, sensory tests and sensory-motor tests. Each applicant was required to pass these before acceptance.

Twenty of the most expert motormen and conductors were selected as instructors. These men were ranked as "instructor," with a special cap band; their authority was increased. They were taught what to teach new men and how to go about the teaching. Instructors' meetings were, and still are frequently held. Students were sent only to regular instructors. A student under the new plan has but one instructor, who is entirely responsible for his training. This instructor takes him over every line in the city and teaches him all details of equipment and operation. Under this plan the time required to train an operator has been decreased from twenty to nine and ten days.

In writing about the system in the *Texas Industrialist* Mr. Crampton says that men trained under the new system are first taught to appreciate their job, and those who do not like it are encouraged to seek other employment at once. Courtesy and safety of operation are stressed at every point. After the student has mastered the duties of a trainman, he is approved by his instructor as fit for employment. He then passes a written examination which covers in detail the many phases of operation. These papers are preserved as an evidence, that he received proper training, and are an effective means of eliminating future excuses based on the plea of ignorance.

New men are employed for a three months' probationary period. During this time they report twice monthly to the superintendent of employment and training for review of their record and questions. At the end of three months' successful trial they are permanently employed.

Instructors are held responsible for the success of their students. Cumulative records are kept of each student and each instructor. On these records are noted such things as accidents, reckless actions, courtesy, unusual merit, etc. In this way the efficiency of instruction is stimulated and measured.

Mr. Crampton offers as a proof of the success of the plan statistics of traffic during the last State Fair. Approximately 50 per cent of the traffic during this period was handled by men trained under the new system. Traffic dangers were greatly increased by numerous strangers who were unfamiliar with the city. During the sixteen days of the fair there were only nineteen accidents that involved personal injury. None of these was serious. Not a bone was broken. On this basis the personal injury record represented one accident for each 190,000 passengers carried. On children's day, when free fair and railway tickets were provided, not a child was hurt.

Another Company Installs the Zone Pass

Since July 24 the Houghton (Mich.) County Traction Company has been using the unlimited ride, transferable weekly pass. The lines constitute what is practically an interurban railway, the chief headways being one hour or thirty minutes, although four cars an hour are operated between the twin cities of Hancock and Houghton.

Necessarily, the passes are sold on the zone basis. The rates are $0.98, $1.80 and $2.25 as against cash fares of 9, 18 and 27 cents respectively. Coincident with the installation of passes, S. B. Tuell, receiver, was permitted to discontinue the 8 cents per zone ticket rate.

As the passes were installed during the low-ride summer weeks and in a period of great depression, they have not yet had a chance to show what they can achieve in ride stimulation and revenue increase. However, with the pass sales equal to about 10 per cent of the total revenue, it is noted that the company without suffering any loss in revenue has been able to give a greatly decreased fare per ride to its regular customers. Walter Jackson co-operated with the receiver of the company in working out the rates and the publicity program.

May Adopt One-Way Traffic Plan

That one-way traffic in the city of Portland, Ore., must be tried in the congested district of the city was the consensus of opinion recently among City Councilmen. A resolution has been passed directing City Attorney Grant, Chief of Police Jenkins and City Engineer Laurgaard to make a survey of traffic conditions and prepare an ordinance requiring one-way traffic. The resolution was adopted without dissent. Mayor Baker introduced the resolution. Should the survey of traffic conditions develop that other reforms are necessary to relieve congestion on Portland's narrow downtown business streets such reforms will likely be included in the report. Although the plan of one-way traffic is expected to meet with some opposition, it appears that the Councilmen have determined to give it a fair trial.

Transportation News Notes

One Man Cars in Use.—The Port Arthur-Fort William Street Railway, Port Arthur, Ont., on Aug. 4 put into operation one-man cars.

One-Man Interurban Cars Started.—The Louisville (Ky.) Railway will start operating one-man cars on its Jeffersontown and Okolona interurban lines. Some of its cars have been remodeled so that passengers will enter and leave by the front door, and only one man will be required for handling the cars.

Traffic Decreases in August.—Figures filed with the Board of Public Utility Commissioners of New Jersey by the Public Service Corporation show fewer persons traveled on the company's lines in New Jersey in August than in July. Passengers in August numbered 34,370,155, compared with 36,666,407 in July.

15,644 Passengers to Bay View Beach.—According to the report of Superintendent Warwick of the Wisconsin Public Service Company on the operation of the Green Bay Park Railway leading to Bay View Beach, 15,644 passengers were carried in August. There were 9,758 paid fares and 5,886 passengers rode on transfers from city lines.

Three Cents a Mile Authorized.—The Indiana Public Service Commission has authorized the Union Traction Company to charge 3 cents a mile, with a minimum rate of 10 cents for rides within the city of Indianapolis. All traction lines entering Indianapolis now have a 10-cent fare. The old rate was 5 cents and placed the interurban lines in competition with the Indianapolis Street Railway lines.

Fares Reduced.—The Southwestern Traction Company, which operates an electric railway between Temple and Belton, Tex., with local service in both cities, has announced a 12 per cent reduction in fares between the two cities. The fare from Temple to Belton and from Belton to Temple has been reduced from 42 cents to 35 cents and fares between intermediate points in proportion.

Transfers to Settle Issue.—The Trenton, Bristol & Philadelphia Street Railway, Bristol, Pa., has informed the Borough Council of Morrisville that it is unable to run its cars from that place to Trenton, N. J. The Morrisville borough solicitor appeared before the Public Service Commission of Pennsylvania and asked that the company be made to run cars across the Delaware River Bridge. Minot J. Hill, general manager, stated that service was discontinued because the receipts did not meet operating expenses. The Pennsylvania & New Jersey Railway will issue transfers at 6 cents good on the Philadelphia line.

Personal Mention

D. J. Graham Goes to Youngstown

There's a new engineer of maintenance of way on the Youngstown (Ohio) Municipal Railway. He is Dale J. Graham, recently engineer with the American Steel Wire Company, Worcester, Mass., and before that with the Railroad Administration, and previous to that with the New York State Railways at Rochester, and before that with the Pennsylvania Railroad. This summary of Mr. Graham's activities accounts for all his time since he was graduated from the University of Pennsylvania in 1910 except two years with the Santa Fé Railroad in Kansas, Oklahoma and far Southern states. Mr. Graham's appointment was effective early in August.

J. P. Cantu is engineer maintenance of way for the Boston & Maine Railroad. F. A. Merrill formerly held this position.

J. F. McLaughlin is now superintendent of lighting and power of the El Paso (Tex.) Electric Railway, the position formerly held by Prentice M. Hatch.

R. E. Bowen is now associated with the Galveston (Tex.) Electric Company as purchasing agent. F. V. Schneider formerly had charge of this work.

F. C. Coley is now general passenger agent of the Providence, Warren & Bristol Railroad, Providence, R. I. A. B. Smith was heretofore general freight and passenger agent.

A. M. Lynn, of Pittsburgh, Pa., has been elected president of the Steubenville, Wellsburg & Weirton Railway, Wellsburg, W. Va. He succeeds R. B. Keating, who is now vice-president.

F. A. Bryan is now vice-president, instead of Henning Chambers, of the Benton Harbor-St. Joe Railway & Light Company, Benton Harbor, Mich. C. B. Calvert is secretary, filling the place formerly held by L. W. Botts.

C. B. Luscombe is now associated with the Western Light & Power Company, Boulder, Colo., as assistant general manager. Paul Lee is second vice-president. Paul R. Jones formerly held this post.

F. W. Walker has been elected a vice-president of the Milwaukee Northern Railway, Cedarburg, Wis. He continues his duties as general manager and chief engineer, which he has carried for some time. F. V. Benz now holds the position of purchasing agent, formerly held by Otto Maske, and more recently by A. Walker.

Joseph G. Gahm is associated with the Columbus (Ga.) Electric Company as student engineer. Mr. Gahm is connected with Stone & Webster, which controls the Columbus Electric Company. This company owns the Columbus Railroad, the Gas Light Company of Columbus and controls the Columbus Power Company.

Tudor W. Jones Acting Auditor

The appointment of Tudor W. Jones as acting auditor of the Union Traction Company of Indiana, Anderson, Ind., has been announced. The appointment was effective Aug. 15. Mr. Jones succeeds Walter Shroyer, who is now treasurer in place of W. H. Forse, who resigned.

Mr. Jones has been chief clerk in the

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accounting department. He knows the ways of the work, for since joining the company in 1905 he has held every position in the department. His experience also includes that as ticket agent at the Anderson station. This work he did from September, 1905, until March, 1906, when he was first affiliated with the accounting department. Since then his life has been a succession of promotions.

N. A. Sinclair Elected President

Changes in the personnel of the Cape Fear Railways, Raleigh, N. C., have been made recently. N. A. Sinclair of Fayetteville has been elected president to succeed H. L. Jones, of Norfolk, Va. He has assumed the duties of general manager in addition. L. H. Couch becomes vice-president and Alan Turner, secretary and treasurer. G. M. Wislar is in charge as superintendent. W. L. Jones was previously general manager.

Henry Sherman has been appointed chief engineer of the Tide Water Power Company, Wilmington, N. C.

W. C. Slade is superintendent of power and lines of the United Electric Railways, Providence, R. I.

E. W. Hodges is now auditor of the Pacific Gas & Electric Company, Sacramento, Cal.

George C. Wright is traffic manager of the Minneapolis, Northfield & Southern Railway, Minneapolis, Minn.

W. A. Baehr has been elected president of the St. Cloud (Minn.) Public Service Company, to succeed A. G. Whitney.

E. E. Sullivan is purchasing agent of the Marshall (Tex.) Traction Company, a position formerly held by J. E. Meadors. J. C. Kennedy is general manager.

J. C. Martin was recently elected president of the Fort Scott & Nevada Light, Heat, Water & Power Company, Nevada, Mo. He succeeds W. C. Gunn.

S. Murroy holds the position of chief engineer of the Yakima (Wash.) Valley Transportation Company. E. F. Kidder formerly was chief engineer for the company.

S. Fox is superintendent of power and H. W. S. Kelly is engineer of overhead construction of the Cleveland, Alliance & Mahoning Valley Railroad, Ravenna, Ohio.

Obituary

Charles F. Franklin died at his home at Toledo, Ohio, on Sept. 18 after an illness of several weeks, at the age of sixty-three years. He had been retired from active business about five years. Mr. Franklin's first traction affiliation was with the Newburgh (N. Y.) Electric Railway (now the Orange County Traction Company), with which he served as superintendent from 1895 to 1899. He early saw the possibilities in handling freight by electricity and introduced the system on that property. Mr. Franklin later was superintendent of the Winona Interurban Railway, Warsaw, Ind., and president and general manager of the Toledo & Western Railroad, Sylvania, Ohio. The latter property was one of the pioneers in going into the freight business on a steam road basis, and through Mr. Franklin's influence and efforts many producers were induced to locate on the line, especially in towns not served by steam railways. Mr. Franklin is survived by his wife and five children.

R. L. Waddill, a director of the Texas Electric Railway, died at his home in McKinney following an operation. Mr. Waddill was interested in financing and building the interurban line promoted by the late Col. J. F. Strickland. He had been a member of the directorate since the line was built.

Manufactures and the Markets

DISCUSSIONS OF MARKET AND TRADE CONDITIONS FOR THE MANUFACTURER, SALESMAN AND PURCHASING AGENT

ROLLING STOCK PURCHASES BUSINESS ANNOUNCEMENTS

Large Steel Rail Orders Reported

Almost record tonnage orders for steel rails have been reported since the announcement by the Steel Corporation of an advance in price of rails to $43 on Oct. 1. Among the orders so far placed are said to be some sizeable ones for electric railways, but such business is of course a very, very small part of the total rail business of the country. So far as the steam railroads are concerned the orders actually placed were generally expected to exceed 300,000 tons by Oct. 1, when the advance in price becomes effective. At least one other large roller of rails has announced an advance to meet the increase by the Steel Corporation.

It is, of course, impossible to estimate with any real degree of accuracy the added cost to the electric railways during the next year of the advance in the price of rails, but the rail bill of the electric railways for the coming year will probably be up another $750,000 over the sum for the last year. This figure looks puny when compared with the levy of additional cost that will be exacted from the steam railroads, but to some electric railways the extra cost, while it may not be a great burden, will be quite a serious factor.

In 1921 there was nothing like the disposition among electric railways to go ahead with new and reconstruction work that has been manifested this year, but even last year 150 miles of new track were built in the form of extensions and 615 miles of track were rebuilt. The track rebuilt last year was only a little more than 1 per cent of the total mileage of the country, but the prospects early in this year were that the sum spent for rehabilitation and renewal work, to say nothing of extensions, would greatly exceed the total so spent for the last year.

Electrification of Mexican Road Proposed

Information has been received at Orizaba, Mexico, that at the recent annual meeting of the shareholders of the Mexican (Vera Cruz) Railway, held in London, England, provision was made for electrifying the 30 miles of mountain division of the road between Orizaba and Esperanza. The announcement of the proposed improvement came from Vincent W. Yorke, London, chairman of the board of directors. The electric power for operating trains on this portion of the line will be obtained either from the hydro-electric plant of Lord Cowdray and associates situated near Orizaba or an entirely separate plant will be built by the railroad, it is stated.

Mr. Yorke further said that at the shareholders' meeting the action of the Mexican Railway in obtaining a concession for a proposed railroad to run from a point on its Mexico City-Vera Cruz main line to Tampico was ratified and that financial provision for the early construction of this new line has been made. He announced that the cost of its construction would be approximately $8,000,000 United States currency. Both of these projects are to be carried out whether or not the administration of President Alvaro Obregon is recognized by England.

Plans for Louisville Improvements to Be Announced Soon

The Louisville (Ky.) Railway at meetings within the next few days will decide on just what expenditures the company will make in improvements to its power plants, and also what purchases of new cars and equipment will be made. The company has a considerable fund for improvements, held out from the difference between a 5- and 7-cent fare during some nineteen months that the higher fare was in the courts. It is planned to improve the power plant materially and to put on a number of one-man cars. Sam Riddle, vice-president of the company, stated that a definite plan for improvement of equipment, etc., would probably be ready for announcement within a week.

Reasons Given for Decline in Latin-American Trade

The decline in the trade of the United States with Latin America during 1921 is explained by the Bureau of Foreign and Domestic Commerce as being due to a number of factors, chief among which might be mentioned the highly inflated prices in 1920, which gave the impression that the volume of trade, compared with previous years, was larger than was actually the case; the overstocked markets, which were a result of the feverish buying in 1919 and 1920; the steady deflation in prices, which caused merchants generally to keep orders down to a minimum in the expectation of still lower prices; and the appreciation of the American dollar.

Some competition was encountered from other countries trading in the Latin-American field, but aside from the general depression experienced in all of these countries, the greatest obstacle to our trade was the high quotation of the dollar, which tended to throw trade to European countries, whose currency was in most cases greatly depreciated. The details of the United States trade with Latin America are given in the departments' *Trade and Economic Review* for 1921, No. 9.

Record Coal Loadings Reported

A total of 195,142 cars were loaded with coal during the week which ended on Sept. 16, according to reports just received from the railroads by the Association of Railway Executives.

Of this total, 175,326 cars were loaded with bituminous coal, an increase of 17,316 cars over the week before, when, however, there was a falling off in coal loadings due to the observance of Labor Day. The remaining 19,816 cars were loaded with anthracite coal during the past week, which was the first week of production since the recent agreement was reached between anthracite operators and miners.

On the basis of these loadings, coal production during the week ended Sept. 16 approximated 10,633,000 tons, of which 9,650,000 tons consisted of bituminous coal and 983,000 tons were anthracite coal.

A total of 5,088 cars were loaded with anthracite coal on Sept. 16, the largest number for any one day since operations were resumed in the anthracite fields, and 384 cars in excess of the preceding day. This was within 363 cars of the average daily loading in September last year.

Loading of bituminous coal on Saturday amounted to 25,073 cars, 2,798 cars below the preceding day. Coal loadings in the bituminous fields, however, always show a decrease on Saturday compared with other days in the week.

Easterners Negotiating for Barney & Smith Plant

It is said to be probable that the Barney & Smith Car Company's plant at Dayton, Ohio, will be sold to Robert J. McGare, New York. Mr. McGare was in Dayton on Sept. 14 to confer with Valentine Winters, president of the Winters National Bank and receiver of the car company. It was explained that all of the necessary machinery to resume car building is installed in the Dayton plant, one of the largest in the country.

Tenders Out for Bombay Electrification

It is reported that tenders have been asked in London for the electrification of the Bombay Suburban Railways. It is understood that the total expenditure will probably approximate £2,000,000.

Metal, Coal and Material Prices

Metals—New York	Sept. 19, 1922
Copper, electrolytic, cents per lb.	14.00
Copper wire base, cents per lb.	15.625
Lead, cents per lb.	6.10
Zinc, cents per lb.	7.00
Tin, Straits, cents per lb.	32.125
Bituminous Coal, f.o.b. Mines	
Smokeless mine run, f.o.b. vessel, Hampton Roads, gross tons	$8.075
Somerset mine run, Boston, net tons	4.875
Pittsburgh mine run, Pittsburgh, net tons	4.625
Franklin, Ill., screenings, Chicago, net tons	4.425
Central, Ill., screenings, Chicago, net tons	3.625
Kansas screenings, Kansas City, net tons	2.625
Materials	
Rubber-covered wire, N. Y., cents per lb.	6.00
Weatherproof wire base, N.Y., cents per lb.	16.00
Cement, Chicago net prices, without bags	$2.20
Linseed oil (5-bbl.lots), N.Y., cents per gal.	91.50
White lead, (100-lb.keg), N.Y., cents per lb.	12.50
Turpentine, (bbl. lots), N.Y., per gal.	$1.32

Rolling Stock

New Brunswick Power Company, St. John, N. B., has converted all its open cars into closed cars, thereby eliminating the necessity of purchasing additional rolling stock.

Wisconsin Public Service Company, Green Bay, Wis., will spend approximately $10,700 on the new one-man interurban cars which will replace the two-man cars now in operation. This improvement has been referred to previously in these columns.

Municipal Railway, San Francisco, Calif.—Contracts have been awarded by the city and county of San Francisco for twenty car bodies and their equipment. The bodies will be built by the Bethlehem Shipbuilding Company, Twentieth and Illinois Streets, San Francisco, at $152,520, the trucks will be supplied by the Standard Motor Truck Company at $28,551, the motors by the Westinghouse Company at $119,777 and the airbrake equipment by the Westinghouse Traction Brake Company at $11,008.

Washington Railway & Electric Company, Washington, D. C., has placed an order with the J. G. Brill Company for ten 28-ft. 5-in. closed motor car bodies. These cars will be equipped with automatic safety devices and are intended for one-man operation. The cars are different from the standard Birney cars, particularly in that they are to be mounted on maximum traction trucks with G. E. 257 motors and will have monitor deck roofs. The construction will be composite in that the underframe will be of steel and the frame of the superstructure of wood.

Track and Roadway

Wisconsin Public Service Company, Green Bay, Wis., has extended its line 2 miles to the West Walnut Street line.

Savannah Electric & Power Company, Savannah, Ga., has recently installed a new curve in the track at West Boundry and York Streets.

Milwaukee Electric Railway & Light Company, Milwaukee, Wis., has been granted a franchise to construct either a single or double track line on the Port Washington Road to Lincoln Park.

Gloucester, N. J.—The board of directors of the Gloucester, N. J., Chamber of Commerce has discussed a proposed belt line from one end of the city to the other. A survey will be made by an engineer to determine just where the line can best be run to connect with all manufacturing plants.

Ohio Valley Electric Railway, Huntington, W. Va., will make a big improvement in service on the Twelfth Avenue line by the installation of a switch between Eighth and Ninth Streets. Work on the switch which has been started may delay the service temporarily. The company's Sixth Avenue line is undergoing repairs.

Georgia Railway & Power Company, Atlanta, Ga., announced some time ago that it would begin immediately the repair work between the car tracks in Lee Street from Park Street to McCall's Crossing. F. L. Butler, general manager of the company, said that it was the purpose of the company to lay new rails between Park Street and Gordon Street.

Kansas - Oklahoma. — The proposed construction of an interurban railway which will link the Kansas coal fields with the lead and zinc deposits of northeastern Oklahoma has been announced by J. J. Heim, president of the Joplin & Pittsburgh Railroad. It is proposed to extend the line from Columbus, Kan., to Picher, Okla., a distance of 11 miles. The Chamber of Commerce at Columbus, Kan., has been asked to issue bonds of $20.000 to aid in securing the extension into Oklahoma.

Seattle, Wash.—A. E. Pierce, Construction Engineer of the Seattle Municipal Railways Department, announces that railway construction and maintenance work now proceeding in the city will total a cost of $1,250,000. The largest of the present undertakings is the retracking of First Avenue and First Avenue South, estimated to cost $250,000. Next year's renewal and reconstruction work is to cost approximately $824,460.

Kansas City (Mo.) Railways during the past few months has completed two track rehabilitation jobs. The first of these was the reconstruction of Eighth Street from Wyandotte to Broadway. This work, completed about Aug. 5, cost in the neighborhood of $14,000. The reconstruction of Grand Avenue from Twelfth Street to Fifteenth Street was begun on Aug. 1 and is to be completed this month at an approximate cost of $35,000. These improvement plans were referred to in the issue of July 22.

Power Houses, Shops and Buildings

The Windsor, Essex & Lake Shore Rapid Railway, Kingsville, Ont., has started work on its new terminal on Oak Street, Leamington.

Eastern Wisconsin Electric Company, Sheboygan, Wis., will spend $50,000 for the erection of a new carhouse and repair plant in Oshkosh to replace buildings burned in June.

United Electric Railways, Providence, R. I., has received permission from the town of East Providence to erect a large carhouse of brick on North Broadway, near Massasoit Avenue. It is planned to start construction in a few weeks and to have the structure completed by Jan. 1, 1923.

Boston (Mass.) Elevated Railway has awarded the contract to the Simpson Brothers Corporation, Boston, for the substructures and foundation work in connection with the construction of two 160 x 300-ft. and two 53 x 56-ft. car repair shops and a 80 x 731-ft. transfer yard, etc., to cost $3,000,000, at Everett, Mass. Dwight P. Robinson & Company, New York, are the engineers.

Salt Lake City, Utah.—Actual construction of the passenger depot of the Salt Lake Terminal Company at the southwest corner of West Temple and South Temple Streets will commence as soon as the necessary changes can be made in the drawings and contracts for the work let. The structure will cost approximately $200,000. This announcement has been made by W. C. Orem, president and general manager of the Salt Lake & Utah Railroad, which company, together with the Bamberger Electric railroad, forms the Terminal company. Sale of certain bonds upon which work on the building has been pending has resulted in the above announcement. Construction work is expected to be completed not later than next spring.

Trade Notes

National Railway Appliance Company, New York, N. Y., has moved its offices from 452 Lexington Avenue, corner of Forty-fifth Street, to the Transit Building, 7 East Forty-second Street.

The Ward Leonard Electric Company, Mount Vernon, N. Y., announces the appointment of Willis D. Bishop of Montreal, Quebec, as selling representative in the Province of Quebec. He has been closely identified with the design, application and sale of control apparatus and switchboards since 1904, and is therefore well qualified to represent the Ward Leonard line of electrical control apparatus.

Louisville Frog & Switch Company, Louisville, Ky., announces that F. W. Carter, formerly assistant manager of the heavy traction division of the Westinghouse Electric & Manufacturing Company, has now become president of the Louisville company. Mr. Carter was connected with the New York office of the Westinghouse company for four years doing heavy traction work.

Westinghouse Traction Brake Company announces that G. B. Pierce of St. Paul, Minn., has been appointed air brake engineer for the Far East and will sail for Japan in September to establish headquarters in Tokyo with W. G. Kaylor, manager of the Westinghouse Traction Brake and Westinghouse Air Brake interests in the Orient. Mr. Pierce will also represent the Westinghouse Air Brake Company. He will collaborate with Mr. Kaylor in a territory covering Japan, China, Manchuria and Korea. Mr. Pierce has been with the Westinghouse Air Brake Company as a mechanical expert in St. Paul for twelve years. He was formerly a locomotive engineer and acting road foreman of engines on the Montana division of the Northern Pacific Railroad. One of Mr. Pierce's chief duties in the Orient will be that of instructing railway employees in the operation and maintenance of Westinghouse brake equipment.